"URBAN DEVELOPMENT STRATEGIES FOR PERIPHERAL AREAS ALONG METRO EXTENSION TOWARDS HINGNA"

Project Phase-II Report

Submitted to
Visvesvaraya National Institute of Technology,
Nagpur in partial fulfillment of the requirements
for the award of the degree

MASTER OF TECHNOLOGY

IN

URBAN PLANNING

By

Shipra Gadge (MT23UPL024)

Under the guidance of

Prof. Kishor Joglekar

Department of Architecture & Planning

Visvesvaraya National Institute of Technology

Nagpur 440010 (India)

2024-2025

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Department of Architecture and Planning

Visvesvaraya National Institute of Technology, Nagpur

Declaration

I, **Shipra Gadge**, hereby declare that this project titled **"Urban development strategies for peripheral areas along metro extension towards Hingna"** is carried out by me in the **Department of Architecture and Planning** of Visvesvaraya National Institute of Technology, Nagpur. The work is original and has not been submitted earlier whole or in part for the award of any degree/diploma at this or any other Institution / University.

Shipra Gadge

Date:

Certificate

This to certify that the project Titled **"Urban development strategies for peripheral areas along metro extension towards Hingna"** is submitted by **Shipra Gadge** in partial fulfilment of the requirements for the award of the degree of **Master of Technology in Urban Planning**, VNIT Nagpur. The work is comprehensive, complete and fit for final evaluation.

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Visvesvaraya National Institute of Technology, Nagpur

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I express my deep gratitude to Dr. Sameer Deshkar, Head of the Department, Department of Architecture and Planning, and Chairman & Director, Visvesvaraya National Institute of Technology, Nagpur, for providing all the necessary facilities to carry out study for Project Phase II.

Last but not the least; I am thankful to my parents and for their moral as well as financial support.

- Shipra Gadge

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Prof. Kishor Joglekar

Professor,

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ABSTRACT

Urban expansion in Indian Tier-2 cities is increasingly shaped by the development of metro systems, presenting both opportunities and challenges for sustainable growth. This study explores urban development strategies for the peripheral corridor between Lokmanya Nagar and Hingna, aligned with Nagpur Metro Phase 2. As urban sprawl, unplanned land use, and fragmented infrastructure dominate peri-urban growth, the metro corridor offers a unique chance to apply Transit-Oriented Development (TOD) and Transit-Activated Corridor (TAC) frameworks to foster compact, connected, and inclusive urban environments.

The report evaluates the current urban form, land use patterns, infrastructure conditions, and population growth across a 1 km influence zone of the proposed metro corridor. Station-wise analysis reveals high TOD potential in nodes like Wanadongri and Hingna, where institutional, residential, and commercial pressures intersect. Drawing from national and international best practices—including TOD initiatives in Singapore, Delhi, Copenhagen, and Ahmedabad—the study proposes five integrated interventions: creation of a TAC overlay zone with revised DCR norms, micro-level land pooling policies for small plot redevelopment, vertical mixed-use development at metro stations, design of multimodal interchange hubs, and a sustainable public realm strategy focusing on green mobility.

Each proposal is based in local challenges such as narrow roads, unregulated autos, and fragmented land ownership, with phased implementation frameworks and monitoring mechanisms. The project concludes by highlighting the importance of aligning land use regulations, infrastructure planning, and mobility strategies to transform the metro corridor into a high-performing urban spine. The outcome is a replicable model for structured and transit-led urbanization in India's expanding urban peripheries.

Keywords

Transit-Oriented Development (TOD), Transit-Activated Corridor (TAC), Metro Corridor, Urban Redevelopment, Multimodal Integration, Land Use Planning, Public Realm, Nagpur, Sustainable Urbanization, Peri-Urban Growth.

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1. INTRODUCTION

1.1 INTRODUCTION

Urban transportation is a strong land-use driver and is a central driver of the spatial and socio-economic structure of the city. Among the different models of mass transit, metro rail systems have come to represent city-transformation infrastructure for Indian cities, and their impact not only on transport modes but also with the catalysing of real estate development, remaking land values, and re-crafting the morphology of the city. The development of suburban and peripheral metro corridors is an opportunity and challenge—at can urge for sustainable city growth if it is supplemented with collective planning measures.

Metro rail systems are designed as central tools to reduce traffic jams, lower emissions, and increase the use of public transport. The existence of such systems tends to initiate transit-oriented, high-density, mixed-used development, particularly around stations. But without integral planning, such corridors are likely to be subject to random and unorganized development. Speculation, unplanned densification, strain on infrastructure, and station congestion become typical side effects, making a latent value of such tremendous investments worthless.

Transit-Oriented Development (TOD) provides an integrated approach to reduce the mismatch between transport infrastructure and land use. Focusing on dense, walkable, mixed-use precincts near transit stations, TOD supports green and equitable urban development. Also, complementary strategies in multimodal connectivity improvement, station area planning, and zoning reform are essential in order for metro investments to realize long-term environmental, socio-economic, and economic dividends.

The planned extension of the Nagpur Metro is a prime example where urban planning can be harmonized with infrastructure growth. The project thus aims to frame Urban/Precinct Development Strategies for the Metro line. The goal is to tap the transformational potential of metro expansion and guide towards planned, transit-based urban development. The study aims at avoiding the ills of uncontrolled expansion and instead utilizing metro infrastructure as a catalyst for planned, sustainable urban renewal.

1.2 BACKGROUND OVERVIEW

Development of metro rail networks in Indian cities has turned out to be a revolutionary solution to urbanization at a rapid rate, increasing traffic congestion, and mobility solution demands that are sustainable. While metro corridors are primarily developed with a focus on public transport accessibility and reducing travel times, their impacts extend way beyond mobility. They have a significant influence on land value, land use, urban shape, and the ability for development surrounding them. Consequently, the zones surrounding metro stations these are generally called "station precincts" are very active city spaces.

Historically, Indian cities have experienced uncoordinated land development after large-scale infrastructure projects. In most instances, the failure has resulted in spontaneous growth, encroachments, traffic congestion, and loss of public space. The absence of well-planned precinct development strategies has also been discouraging the potential of the transit system to transform cities in a revolutionary way decisively.

This has led to a focus on Transit-Oriented Development (TOD) a commonly employed strategy that coordinates land use planning and transport planning for the purposes of producing compact, walkable, and mixed-use urban areas. TOD works best in conjunction with station area planning, zoning change, multimodal integration, affordable housing supply, and improving the public realm. These elements forms the foundation of urban or precinct development policy.

With metro development in India, these strategies now become vital to ensure the best return on investment in infrastructure, create people-friendly and accessible station neighbourhoods, and foster inclusive urban growth. Peri-urban and suburban peripheries require more of these kinds of initiatives since these areas are lacks with a regulatory environment, lack dispersed ownership, and are liable to speculative development.

Urban/precinct planning strategies are therefore intended to fulfil three chief functions:

- Managing future land use change in an orderly and holistic manner.
- Encouraging efficient operation of metro infrastructure by coupling land use planning and transport planning together.
- Creating pedestrian-friendly, walkable, and resilient mass transit urban neighbourhoods.

It is most felt in cities like Nagpur, Pune, and Kochi— second-tier cities where metro expansion is intruding into rapidly changing areas in the lack of quality micro-level planning. Without it, risks of missing the opportunity to direct growth on sustainable and inclusive terms.

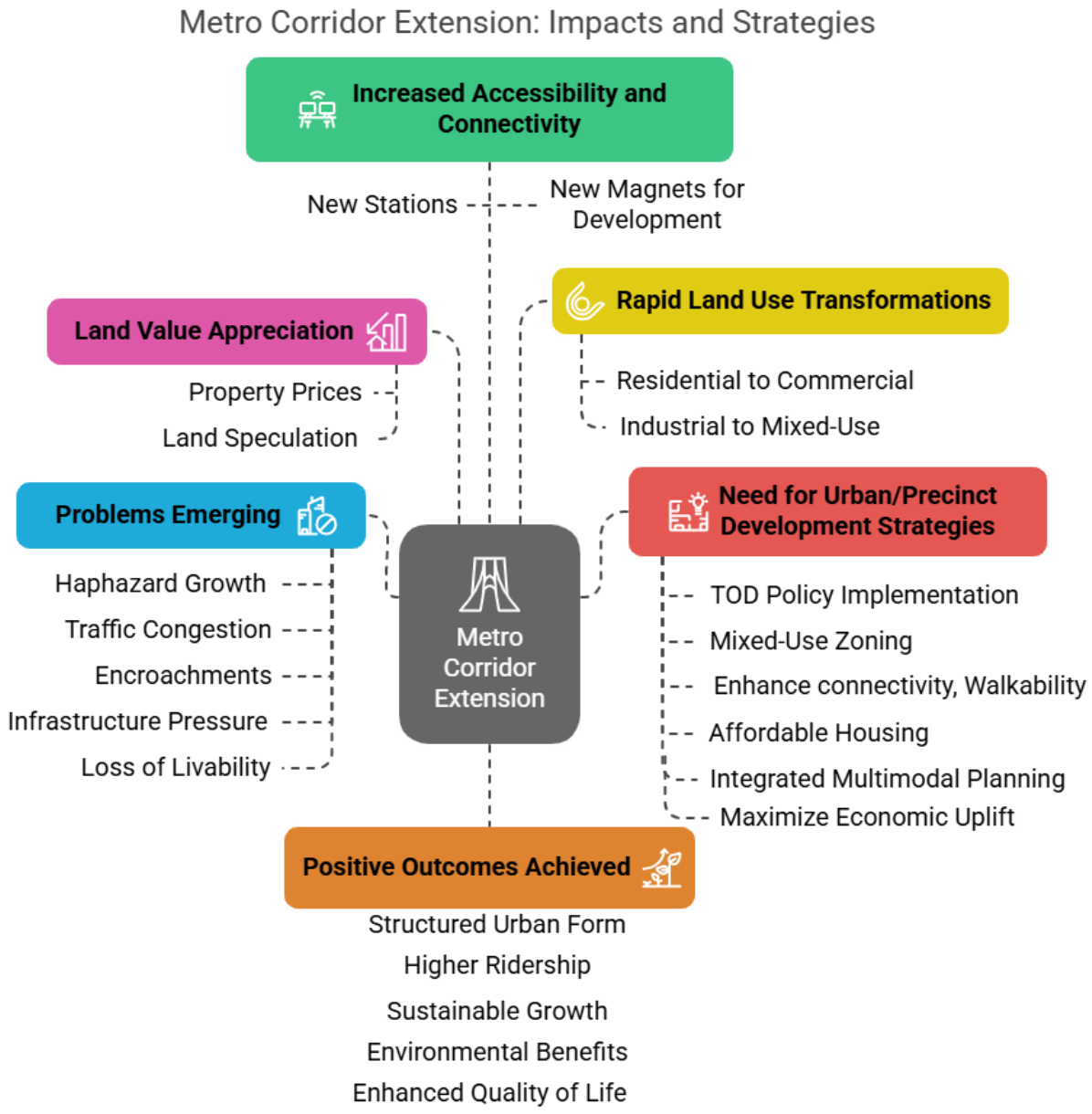


Figure 1- Metro corridor impact & Strategies

1.3 NEED OF STUDY

Extension of metro rail corridors into peri-urban and suburban regions of Indian cities is accompanied by transformative potential for land use, mobility, and economic development. Lack of proactive planning systems and regulatory mechanisms, however, tends to lead to fragmented development, preventing long-term gains from such infrastructure. The project is driven by the significant need to bridge the gap between investing in metro infrastructure and planning for sustainable, inclusive urban growth at the precinct level.

Unlocking Transit-Oriented Development Potential

With metro extensions unavoidable in expanding accessibility and initiating land value appreciation, the potential of Transit-Oriented Development is latent in the lack of clearly articulated and directing principles. The growth must be directed with a concentrated plan to transform it into walkable, mixed-use, and compact neighbourhoods.

Prevention from Unplanned and Unorganized Growth

Post-metro development in most Indian cities has been unstructured densification, traffic, illegal encroachment, and substandard public spaces. Unstructured development not only threatens metro efficiency but also the liveability of the city. Strategic planning of precinct development is crucial to overcome these negative impacts.

Improvement of First- and Last-Mile Connectivity

The success of all metro is not just dependent on its fundamental infrastructure but also the effectiveness of its integration with other transport modes. Station-area planning is an essential contribution in facilitating pedestrian, cycle infrastructure, and feeder service, increasing ridership as well as users' experience in the overall system.

Maximizing Socio-Economic and Environmental Benefits

By utilizing land value growth along metro stations, precinct planning facilitates affordable housing, enhanced public realm, and infrastructure financing through mechanisms such as Land Value Capture (LVC). This makes sure that the metro development economic gain are shared properly and invested back into society.

Encouraging Sustainable Urbanization

Strategically designed precincts promote increased densities, mixed use, and shift to public transport use. The combined factors lead to a decrease in urban sprawl, lowering greenhouse gas emissions, and achieve resilient urban forms according to the sustainable development principles.

Ensuring Policy and Regulatory Framework

The main issue Indian cities are facing is that master planning, DCR, and metro planning are not aligned .The goal of the study is to provide vision on how harmonizing land use policy, zoning policy, and transport investment will result in coordinated, long-term city development.

In the case of cities like Nagpur—where metro development is extended to such neighbourhoods experiencing rapid transformation—such precinct-level planning is not just opportune but inevitable. This study seeks to offer guidance and facilitate well-informed decision-making to realize the vision of inclusive, efficient, and transit-oriented urban futures.

1.4 AIM

"To develop sustainable urban development strategies for transit-oriented precincts along the proposed metro corridor towards Hingna.

1.5 OBJECTIVES

- To Assess the Existing Urban Development Patterns and challenges along the transit corridor.
- To evaluate the potential for implementing Transit-Oriented Development (TOD) focusing on land use, density and connectivity.
- To analyse infrastructure connectivity needs, and the socio-economic impacts of metro development.
- To propose urban development strategies and policy interventions along metro corridor.

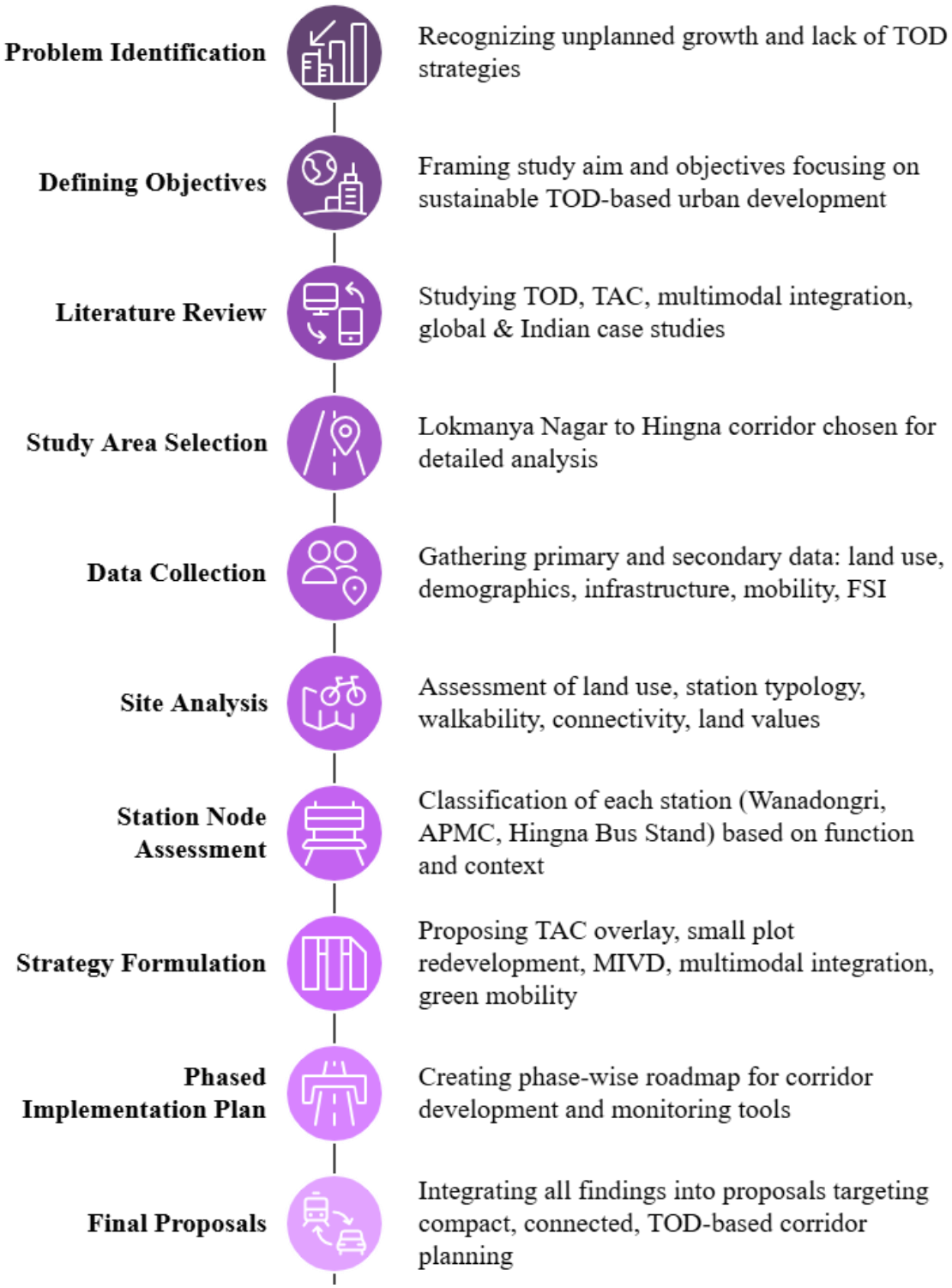
1.6 SCOPE

- The study focuses exclusively on the proposed extension of the Lokmanya Nagar to Hingna Metro Line and its influence zone**,** primarily within a 500m to 1km radius of each station.
- It examines current land use and urban growth trends along the corridor.
- It evaluates the applicability and feasibility of TOD principles in the local context.
- It includes assessment of physical infrastructure, connectivity, zoning regulations, and urban form.

1.7 LIMITATION

1. The research may be limited on expected data from relevant sources.
2. Limited to selected corridor only.
3. Primary data collection analysed through various field surveys and stakeholder interactions.

1.8 METHODOLOGY


Problem Identification
Recognizing unplanned growth and lack of TOD strategies
Defining Objectives
Framing study aim and objectives focusing on sustainable TOD-based urban development
Literature Review
Studying TOD, TAC, multimodal integration, global & Indian case studies
Study Area Selection
Lokmanya Nagar to Hingna corridor chosen for detailed analysis
Data Collection
Gathering primary and secondary data: land use, demographics, infrastructure, mobility, FSI
Site Analysis
Assessment of land use, station typology, walkability, connectivity, land values
Station Node Assessment
Classification of each station (Wanadongri, APMC, Hingna Bus Stand) based on function and context
Strategy Formulation
Proposing TAC overlay, small plot redevelopment, MIVD, multimodal integration, green mobility
Phased Implementation Plan
Creating phase-wise roadmap for corridor development and monitoring tools
Final Proposals
Integrating all findings into proposals targeting compact, connected, TOD-based corridor planning

2. LITRETURE STUDY

Urban transport systems have a decisive influence on the growth, organization, and operations of cities. With urbanization, particularly in the case of developing nations such as India, there is increasing awareness regarding how transport infrastructure is to be harmonized with land use planning. The following key concepts are the basis for realizing sustainable development practices and implementation along transit corridors.

2.1 CONCEPT

2.1.1 Transportation as a Catalyst for Change:

- Transport systems form the backbone of urban development, influencing the form, function, and growth of cities. Transportation infrastructure has an impact on land values, alters land use patterns, and changes the spatial organisation of cities. Transportation's impact extends beyond physical mobility, causing economic, social, and spatial transformations that shape urban landscapes. Impact on land values:

- Proximity to transport hubs improves land accessibility, increasing property values and attracting investment. Metro systems have driven significant property price increases in nearby areas, whereas poorly connected regions have stagnant growth.

- Transportation encourages mixed-use and high-density development near transit hubs, transforming residential zones into commercial areas. Bengaluru Metro has encouraged IT parks and commercial centres, indicating this shift.

- Efficient transportation networks promote compact, polycentric urban growth and minimise sprawl. Ahmedabad's BRTS promotes transit-oriented development.

- New transport infrastructure unlocks vacant areas, promoting economic growth and social integration. Projects such as the Yamuna Expressway have boosted development in previously inaccessible areas.

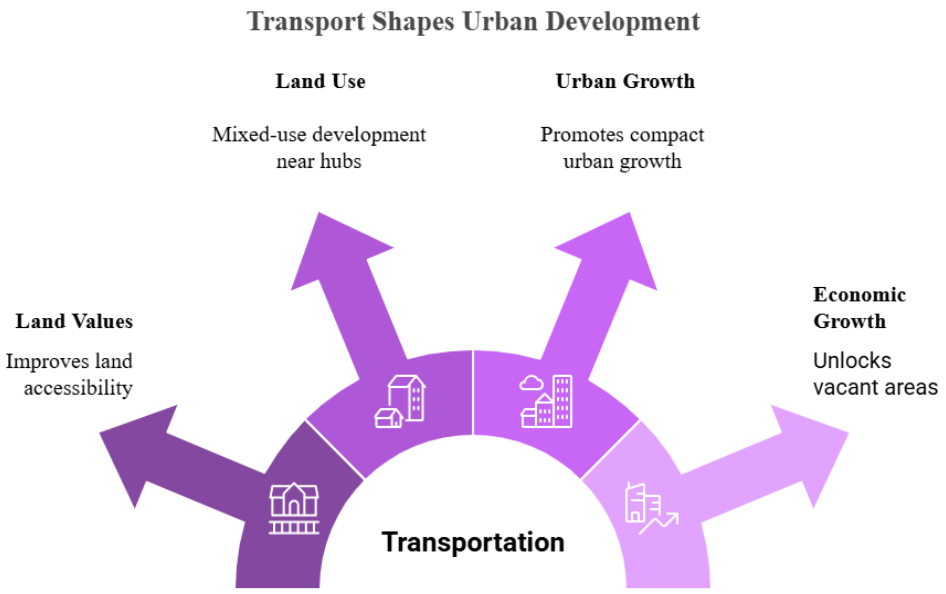


Figure 2- Transportation

2.1.2 Economic Effects

Transport systems have a significant impact on urban economies by increasing accessibility and promoting development. Improved connectivity increases land values, promoting additional commercial and residential development in well-connected areas. This increased demand for property generates economic hotspots that boost local activity and attract private sector investment. The impact extends beyond the immediate transportation hubs, causing a ripple effect that stimulates development in the surrounding areas and promotes overall economic growth.

2.1.3 Urban Form and Density

Compact and higher-density development near transit hubs. Attract residents and businesses, leading to increased population density and commercial development. Promotes mixed land use, Creates vibrant, walkable neighbourhoods to reduce reliance on cars.

2.1.4 Gentrification and Displacement

Raise land values around transit hubs. Increased investment brings residents and businesses. Displacement of Lower-Income Populations due to Rising rents and property prices. Social Inequalities: Without proper policies, transport development can widen economic disparities. Need for Affordable Housing Policies for counterbalance these effects.

2.1.5 Land Use Transport Feedback cycle

Transportation investments shape land use patterns, improves accessibility, impacting where activities, housing, and businesses develop. Land use (new developments, densification) affect how people travel and increase transport demand. Economic, political, demographic, and technological changes influence both transportation and land use patterns. Population growth, rising incomes, and land use regulations impact trip generation, timing, and modes of travel.

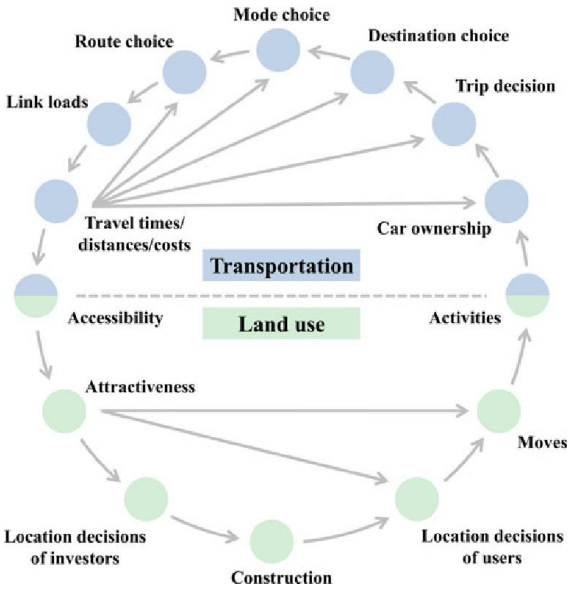


Figure 2-Land Use Transport Feedback cycle

2.1.6 Land Use–Transportation Integration (LUTI)

The interaction between transport infrastructure and land use development is two-way and interactive. Transport infrastructure determines where and how people live, work, and access services, and travel patterns and transport demand affect land use patterns.

Definition- Land Use–Transport Integration (LUTI) refers to the integration of planning for urban form and mobility systems to attain efficient and sustainable urban growth. LUTI seeks to ensure the transport system is planned with the intended land use plan and land development is carried out in a manner that maximizes the efficiency of transport.

- **Key Elements:**
  - **Accessibility**: Provision of an easy mode of access for people to access their destinations through alternative modes.
  - **Urban Density:** The greater density allows efficient public transport and minimizes car use**.**
  - **Functional Mix:** Mixed land use (residential, employment, services) lowers the demand for long-distance travel.
  - **Network Connectivity:** Properly planned street grids facilitate walkability and transit convenience.

- **Temporal Coordination:** Aligning infrastructure investment with land development phasing

- **Assessment Tools:** Accessibility indices**,** Land use mix ratio**,** FSI distribution analysis**,** Trip generation **m**odels

- **Integrated Land Use and Transportation Planning**
  - Coordinate land use and transport: Balance mobility and accessibility.
  - Transport impacts: Plan development to minimize future transport issues.
  - Reduce car reliance: Promote walking, cycling, and public transit.
  - Support community needs: Ensure development is diverse and accessible.

2.1.7 Policy Frameworks and Urban Planning Approaches for Land Use–Transport Integration

- **Master Plans and Development Control Regulations:** Identify land use zoning, Floor Space Index (FSI), and other planning stipulations to define urban development.
- **National Urban Transport Policy (NUTP), 2006:** Encourages transport planning in a sustainable way, emphasizing mobility of people rather than movement of vehicles.
- **Smart Cities Mission:** Promotes compact, connected, and mixed-use urban design, harmonizing metro systems with town planning.

Various policy instruments have emerged to address the growing disconnection between land use and transport. These include:

Policy/Framework	Key Features
National TOD Policy, MoHUA (2017)	Defines TOD as compact, mixed-use development; suggests LAPs and FSI incentives
CMP Guidelines (2013 & 2016)	Mandates integration of land use in transit planning; supports multimodal hubs
State TOD Policies (Delhi, Gujarat)	Operationalize TOD overlays, public realm standards, and land value tools
Local Area Plans (LAPs)	Enable micro-level zoning, road widening, and public space design
Development Control Regulations (DCRs)	Mechanism to enforce land use, FSI, setback, frontage, and form-based codes

Table 1-Urban Planing Approaches

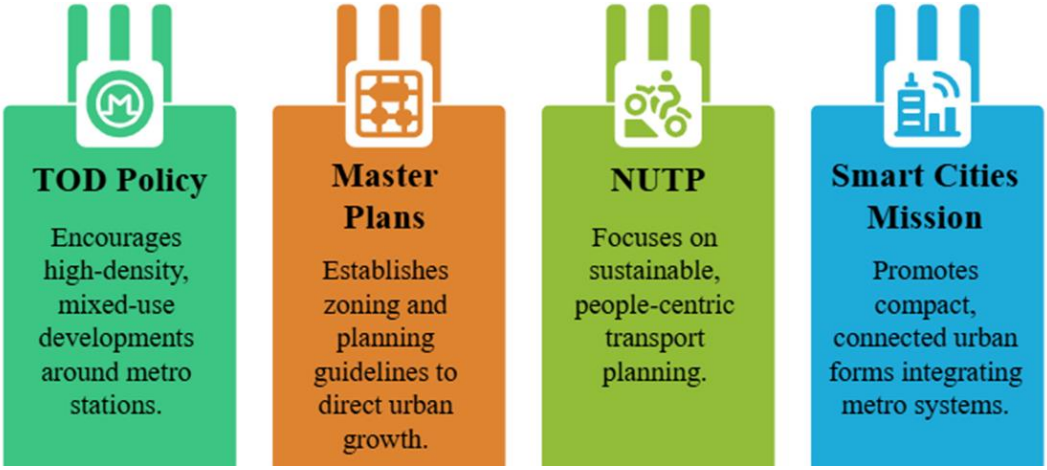

TOD Policy
Encourages high-density, mixed-use developments around metro stations.
Master Plans
Establishes zoning and planning guidelines to direct urban growth.
NUTP
Focuses on sustainable, people-centric transport planning.
Smart Cities Mission
Promotes compact, connected urban forms integrating metro systems.

Figure 3-Policies & Framework

- **Transportation and land use patterns are inextricably linked**.

Transportation facilities and networks have the power to shape development, influence property values, and determine a neighbourhood's character and quality of life. In addition, transportation investments have important consequences for the environment, including air and water quality, climate change, and open space preservation. How communities develop also affects how convenient and appealing public transportation, bicycling, and walking are for their residents.

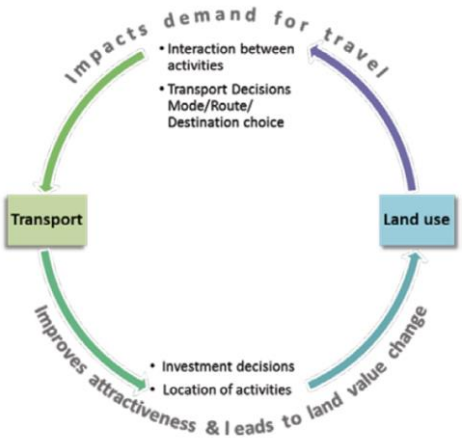

Impacts demand for travel
• Interaction between activities
• Transport Decisions Mode/Route/ Destination choice
Transport
Land use
• Investment decisions
• Location of activities
Improves attractiveness & leads to land value change

Figure 4- Transportation and land use cycle

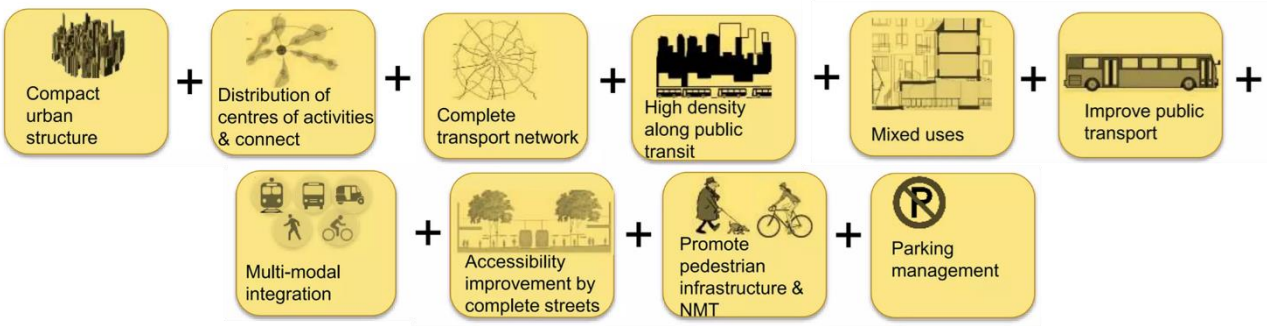


Figure 5- Transportation and land use patterns linkage

- **Multimodal Transit:** A transportation system that integrates multiple modes of travel, such as walking, cycling, buses, and trains, to provide seamless connectivity and improve overall mobility within a city.
- **Compact Area Concept:** Emphasizes a walking, bicycling, and transit-supportive environment with increased density and mixed land uses, particularly in traditional core areas.
- **Radial Development Concept**: Supports a multi-modal transportation system connecting mixed-use centres along major corridors, preserving open spaces and lower-density areas outside the corridors.
- **Land Use Mix:** The arrangement of various land uses, such as residential, commercial, educational, and recreational, within a neighborhood or city. A well-mixed land use promotes accessibility to amenities by walking or using non-motorized transport, reducing the need for long-distance travel.

2.1.8 Role of Public Transportation System in shaping Urban Growth

- **Enhance Accessibility**

  Metro systems enhance intra-urban connection, and cities become more inclusive and accessible. This corresponds to reduced movement hindrances and greater access to facilities for all segments of society.

- **Minimize Car Dependency**

  Mass transit contributes to a modal shift from private cars, lowering traffic congestion and air pollution. It promotes greener and lower-carbon urban mobility levels.

- **Promote Compact Development**

  Metros allow for high-density, mixed-use, pedestrian-friendly urban layouts. This encourages active, transit-reliant communities and efficient use of land.

- **Promote Economic Development**

  Enhanced transit access spurs development and investment on corridors. This generates increased employment, retailing, and land value increases.

2.1.9 Metro Rail Expansion and Its Influence on Urban Development

Metro systems leave deep impacts on land use patterns, shifting towards more intensive development around the stations. Metro systems support mixed-use buildings having residential, commercial, and office space, thus optimizing land use. With public transport access minimizing dependency on private means of transport, parking lot requirements are minimized, allowing further vertical growth. This also affects the housing market, as transit-served areas have increased property values, which are positive for current homeowners but could be detrimental to affordability if it is not managed well through inclusive planning policy.

A coordinated metro system well planned can reduce auto dependence significantly, enhancing mobility for low-income residents who do not have private cars. This Translates into social equity by offering better access to job centres, affordable housing, and city opportunity for all socio-economic groups. In terms of urban design and form, metros produce more pedestrian-friendly environments, especially around stations, and have a tendency to spur the creation of new public spaces and plazas, making access to cities more walkable and socially rich.

2.2 KEY PRINCIPLES

2.2.1 Transit-Oriented Development

2.2.1.1 Introduction

- Transit-oriented development (TOD) is a key element of "smart growth" which emerged in the mid-1980s.
- Transit-Oriented Development (TOD) is a land use policy and urban design technique with the goal of creating compact, mixed-use, pedestrian-oriented communities adjacent to high-capacity transit like metro rail, BRT, or suburban rail. The motive is to locate housing, work, services, and amenities within walking distance (about 400–800 meters) of transit stops in an effort to minimize car dependence, enhance accessibility, and promote public transportation use.

Figure 7-Transit-Oriented Development

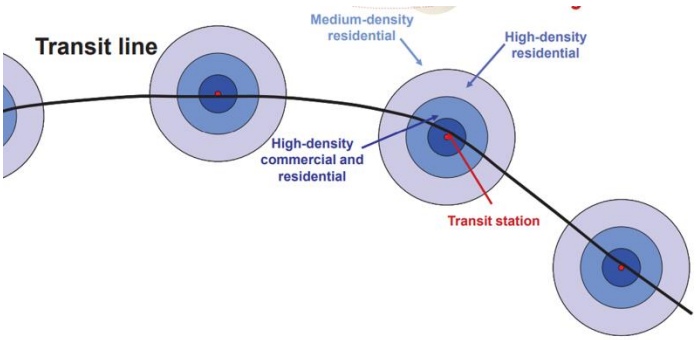


Figure 6-TRANSIT LINE

- **Core station area (400m):** Pedestrian access are significant portion of transit trips.
- **Primary catchment area (800m):** Bike and pedestrian access are major contributors to ridership
- **Secondary catchment area (1.5 km):** Bike, feeder transit, and auto are the primary access modes to and from the stop or station.

2.2.1.2 Transit-oriented Development Principles

- **Density-** Promoting increased population and built-up density in proximity to transit hubs maximizes ridership potential and the economic sustainability of high-capacity public transportation systems. Greater density allows for efficient land use and maximizes infrastructure provision within walking distance of transit. It is generally achieved by reduced Floor Space Index (FSI) requirements and vertical development incentives in a designated station influence area (usually 500–800 meters).
- **Diversity (Mixed Land Use) -** TOD encourages an equitable combination of residential, commercial, institutional, and recreational land uses near each other. Mixed land use diminishes the need for long-distance travel, enhances active communities, and promotes local economic development. Inclusive urban design and adaptable zoning policies ensure that daily activities are incorporated in the same neighbourhood, making the area more self-contained and vibrant.
- **Design (Walkability and Human-Scale Urban Design)-** Quality pedestrian infrastructure is a key component of TOD. People, rather than cars, design spaces and roads. Pedestrian places are characterized by uninterrupted footpaths, covered walkways, street furniture, safe crossings, and lively ground-floor frontages. Design for

people renders the area more secure, accessible, and convenient for everyone, including children, elderly people, and persons with disabilities.

- **Distance (Proximity to Transit)-** Development in TOD is designed within walking distance from stops, normally between 400–800 meters. Being near transit facilities means easy and convenient travel and a decrease in reliance on automobiles. In-closeness block pattern, shorter distances of travel, and direct pedestrian routes help to make this reality, making populations transit-oriented and not highway-oriented.

- **Destination Accessibility-** TOD focuses on strong connectivity within the city and the capacity to access vital destinations e.g., job hubs, schools, and health centres — using safe and reliable transit. By providing transit networks linking high-demand nodes efficiently, TOD fosters equal access to urban opportunities and increases economic productivity.

- **Mobility Options (Multimodal Integration) -** Successful TOD provides unbroken intermodality between different modes of transport — metro, bus, para-transit, cycling, and walking. It facilitates integrated infrastructure, joint ticketing arrangements, common mobility services, and modal interchange stops. The idea is to make an integrated system of mobility available wherein the user can change mode easily, at a low cost, and whenever needed.

- **Public Realm and Community Spaces-** Public space in TOD is conceived to encourage social interaction, environmental sustainability, and cultural expression. It encompasses plazas, parks, shaded seating, and social areas for community meetings. Properly designed public space enhances health, safety, and social cohesion and the quality of the urban environment both in its appearance and function.

- **Land Value Capture (LVC) -** Land Value Capture is a finance mechanism that utilizes the appreciation in land and property value due to investment in transit infrastructure. Premium FSI mechanism, betterment charge, development impact fees, and public-private partnership allow cities to recover some fraction of the infrastructure expense and invest that in urban beautification, upgradation of infrastructure, and low-cost housing.

- **Social Inclusion and Affordability-** Equitable TOD provides access to housing, jobs, and services around transit stops for all income levels. It includes affordable housing requirements, inclusive zoning, and resettlement policy to avoid displacement and gentrification. TOD models facilitate planning on behalf of vulnerable populations and providing access to mobility and opportunity for everyone.
- **Institutional Coordination and Governance-** Implementation of TOD can only be done through collective action of several government agencies, stakeholders, and sectors. Urban planning, transport, housing, and environment departments need to coordinate their actions, underpinned by strong policy frameworks, regulatory tools, and capacity-building programs. Inter-agency coordination and transparent government are critical for effective delivery and oversight of TOD outcomes.

2.2.1.3 Key Features:

- Mixed use involving residential, commercial, institutional, and recreational.
- Parking minimization to discourage private automobile travel.
- Zoning inclusion and affordable housing to avoid gentrification and displacement.

Purpose

TOD promotes citizens to live in close proximity to transit nodes, eliminating the reliance on lengthy trips and permitting dense urban development. It saves land, reduces carbon emissions, enhances mobility by all socio-economic groups, and injects liveliness into the cities.

Main Advantages:

- Enhanced availability of labour and services
- Reduced vehicle ownership cost to households
- Enhanced traffic alleviation and pollution
- Enhanced urban nodes
- Value increase in real property on sustainable bases.

2.2.1.4 Types of TOD (depending on urban intensity and purpose):

- **Urban Core TOD** – High-density mixed-use commercial close to large interchange stations
- **Neighbourhood TOD** – Civic and local retail with medium-density residential
- **Suburban TOD** – Lower-density park-and-ride with transit village orientation

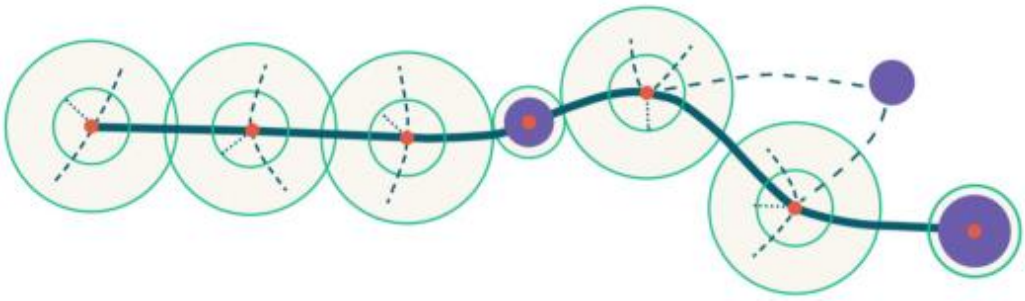
Transit users benefits	Transit operator benefits	Benefits to society
High densities near transit	Increased ridership	Reduced traffic
Pedestrian friendly and walkable Neighbourhoods	multiple transportation choices by multimodal integration	Reduced public infrastructure costs
Increased security near transit stations	Better image	Community liveability
Mixed land use	Lower costs per rider	Increased property values, business

Table 2- Benefits of TOD

2.2.2 Transit-Activated Corridor (TAC)

While TOD is conventionally centred around the station area buffer (typically 500–800 meters), it sometimes fails to activate an entire corridor, particularly in linear, dispersed urban environments. The Transit-Activated Corridors (TAC) strategy bridges this gap by applying TOD concepts to the entire transit corridor — beyond the immediate surrounding station area.

Definition: TAC is a coordinated urban design approach in which development is staged and ignited along the course of a high-capacity transit corridor. TAC unifies transit infrastructure, urban design, and land use into a contiguous and integrated urban fabric instead of discrete station-area improvements.



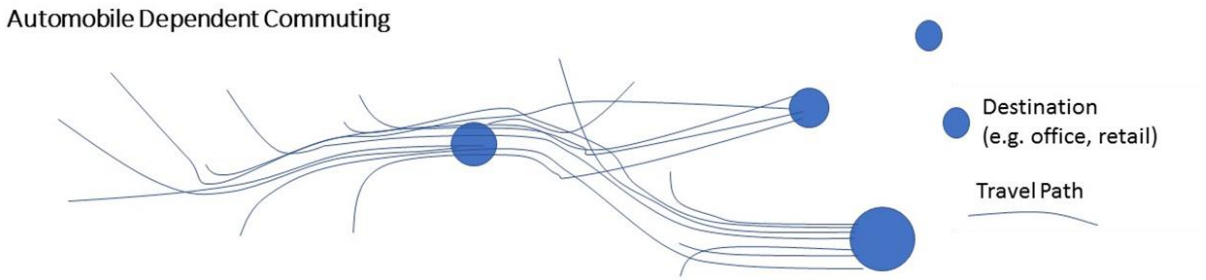


Figure 8-TAC Corridor

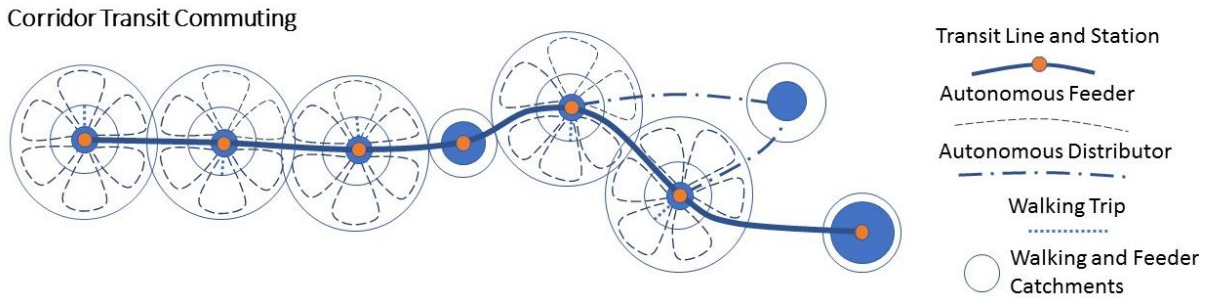


Figure 9- Corridor Transit Commuting

Evaluative characteristics:

- Corridor-scale planning of numerous station areas and land holdings.
- Not only inter-nodal connections between each station impact area.
- Incremental intensification of land use along arterial roads and feeder routes.
- Reactivation of underutilized or brownfield sites along the corridor.
- Public realm improvements underway — streetscapes, cycling networks, transit lanes.

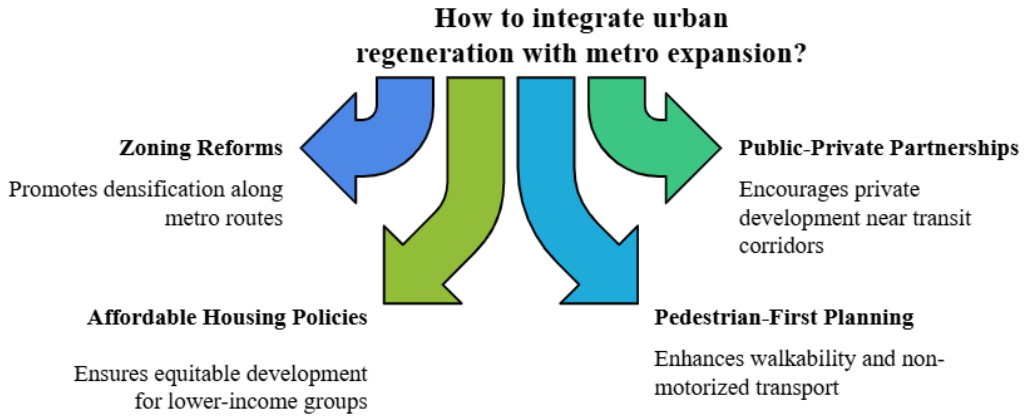

How to integrate urban regeneration with metro expansion?
Zoning Reforms
Promotes densification along metro routes
Public-Private Partnerships
Encourages private development near transit corridors
Affordable Housing Policies
Ensures equitable development for lower-income groups
Pedestrian-First Planning
Enhances walkability and non-motorized transport

Figure 10-Advantages of TAC

Feature	Traditional TOD	Transit-Activated Corridor (TAC)
Focus Area	500–800m around station	Entire corridor from origin to terminus
Land Use Intensity	High near station only	Varies along corridor, more balanced
Connectivity Emphasis	Node-based	Network-based
Implementation Tool	Zoning overlays	Corridor LAPs, TAC frameworks

Table 3-TAC

2.2.3 Integrated Multimodal Transit Interchange Facilities

- **Need for Multiple Modes**: A single mode of transport cannot meet all city transport needs. Multiple modes should be integrated for efficiency.
- **Integrated Multimodal System**: Different modes (like buses, trains, and bikes) should work together, allowing easy transfer between them with minimal time loss.
- **Seamless Movement**: The goal is a smooth, convenient, and quick transition between transport modes, minimizing the need to switch modes during a trip.
- **Enhanced Network and User Experience**: An integrated system increases network resilience and offers more choices, especially when one mode fails.
- **Design and Management**: Effective design and management of transport interchanges maximize benefits, making them safe, accessible, and easy to use.
- **High-Quality Facilities**: Providing a quality environment at interchanges improves user experience and adds social, economic, and environmental value.
- **Physical Integration**: Transport networks (like metro, bus, and rail) should be physically connected to make changing modes easy and support local land use.
- **Fare Integration**: Unified fare systems (like smart cards) reduce costs and simplify ticketing, making public transport more affordable and convenient.
- **Information Integration**: Easy access to transport information helps users make informed decisions about routes and modes.
- **Multimodal Integration Benefits**: Proper integration enhances travel experience, promotes public transport use, and supports urban development

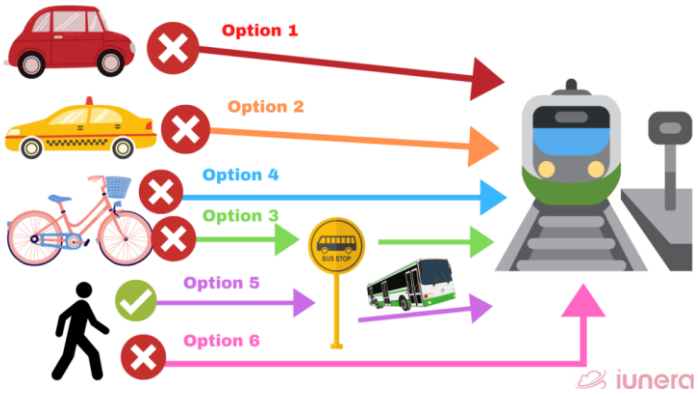
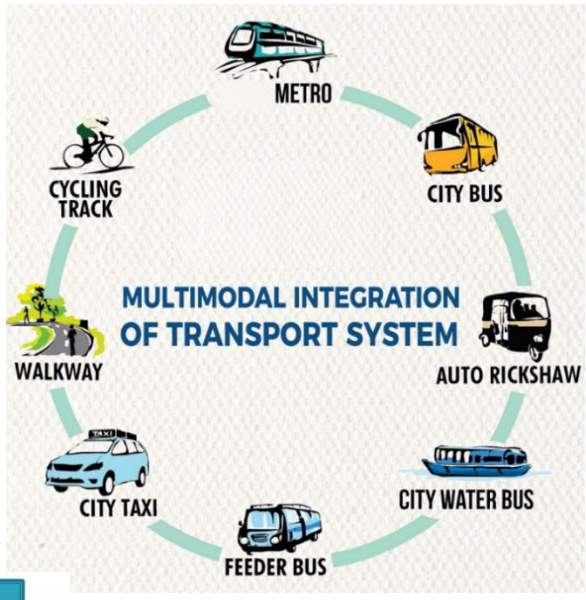


Figure 11- Integrated Multimodal Transit Interchange Facilities



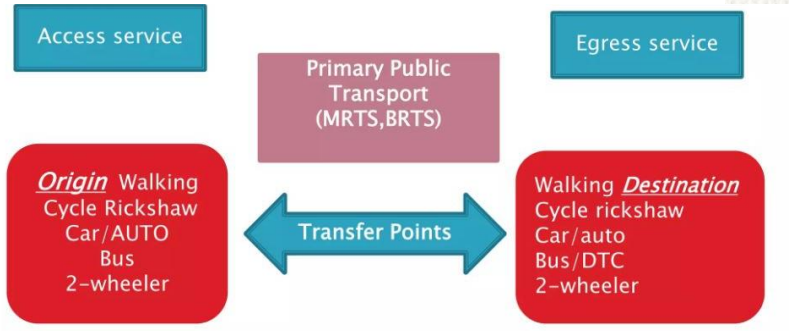


Figure 12-Public Transport

2.2.3 Redevelopment and Re-vitalization

(Inner city, dilapidated areas, slums)

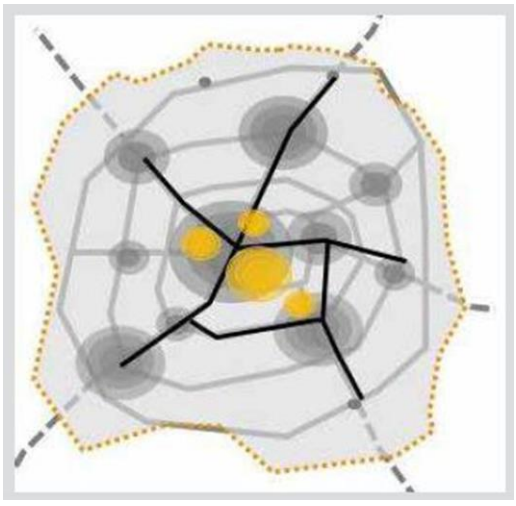


Figure 13-Redevelopment and Re-vitalization

- **Redevelop Core Areas**: Focus on regenerating vacant lands and low-density areas in city centers and along public transport routes to keep the city compact.
- **High-Density Mixed-Use Development:** Prioritize high-density, mixed-use developments in core areas to efficiently use existing urban land and support population growth based on infrastructure capacity.
- **Hierarchical Spatial Planning:** Use a tiered approach to planning, starting with city-wide priorities, then focusing on sub-regions and specific areas, working closely with public sector agencies.

- **Coordination of Planning and Transport**: Ensure spatial and transport planners work together at every planning level to create integrated and viable transport plans.
- **Re-Densify Low-Density Areas:** Re-densify low-density, mixed-use areas and redevelop vacant government or slum-occupied lands in city cores.
- **Redevelop Brownfield Sites:** Redevelop vacant or underused industrial lands in cities to boost the local economy, support sustainable transport, and enhance urban development.
- **Use Legal Tools for Redevelopment:**
    - **Increase Floor Space Index (FSI):** Adjust FSI to control urban sprawl and maintain 7
    - **Spot Zoning:** Allow specific land uses on individual parcels as needed, with caution to avoid favouritism.
    - **Transfer of Development Rights (TDR):** Allow landowners to transfer development rights to protect sensitive areas and direct growth to suitable zones.
    - **Land Pooling/T.P. Scheme:** Collaborate with landowners for public land development, funding costs through enhanced land values and betterment charges.
    - **Promote Sustainable Growth:** Use these strategies to support efficient, sustainable urban growth while preserving important land areas and improving infrastructure.

2.3 Impacts & Challenges

2.3.1 Impact of Urbanization at a High Rate on Land Use Patterns and Mobility Networks

Urbanization at a high rate is an inevitable problem of modern Indian cities. UN-Habitat (2020) states that more than 40% of the population of India will be urban by 2030, and unparalleled stress will be put on land, infrastructure, and mobility networks.

2.3.1.1. Urbanization Impact on Land Use:

- Transformation of farm and open land to residential trends and industrial complexes on the fringes of cities.
- Horizontal Sprawl rather than densification along the vertical axis, particularly in Tier-2 cities such as Nagpur.

- Fragmentation of land parcels, minimizing the provisioning infrastructure efficiency.
- Invasion of Ecologically Sensitive Areas, like water bodies and forests**.**

2.3.1.2. Effects on Transport Networks:

- Long distances due to fragmented urban structure.
- Excessive use of private modes, with low public transport capacity.
- Increased fuel consumption, congestion, and emissions.
- Deteriorating pedestrian and NMT (non-motorized transport) environment.

2.3.1.3 Increasing Urban Footprints

Urbanization is radiating outward in a disorganized and fragmented pattern, producing low-density suburbs. This type of growth increases the travel distances and discourages public transportation systems from being efficient. It also increases pressures on land, roads, and public utilities. Eventually, this results in inefficient space structuring and increased infrastructure costs.

2.3.1.4. Greater Travel Demand

As agglomerations in cities increase, residential and workplace or school mismatch becomes more intense. On a daily basis, this mismatch is experienced in order to travel further, leading to increased use of private cars. Transit systems are not designed to cope with this dispersal of demand. The outcome is paralyzing congestion, pollution, and loss of travel efficiency.

2.3.1.5. Infrastructure Strain

Urbanization is placing huge strain on infrastructure like roads, water supply, sewerage, and public transportation. Very often, these infrastructures are not upgraded to the extent of growth in population and changes in land use. This causes congestion, shortages of water, and poor services. Non-meeting of growth in demand compromises quality of life as well as economic performance.

2.3.2 Metro Systems Impact Land Value, Real Estate Development, and Transit-Oriented Urbanization

Metro systems have a significant role in changing the urban development patterns, especially the nature of land value, land-use patterns, and transit-based urbanization. The most evident effect is likely to be the appreciation in land values around 500–800 meters of the metro station radius. For example, studies in the Delhi Metro observe 20–25% land value appreciation within the station-influence zone, thereby making the transit corridors highly desirable for investment.

Apart from increasing land prices, there is a big real estate movement in development along metro corridors. There is vertical and mixed-use development, with greater demand for living and business spaces near stations because of enhanced accessibility and connectivity.

Apart from that, metro corridors act as a spine to Transit-Oriented Development (TOD). Modern cities also encourage compact and walkable city space that combines residential areas, offices, and shopping districts around metro stations. This yields more sustainable and efficient urban form, less car dependency, and better job and services access.

2.3.3 Challenges of Unplanned Urban Sprawl, Traffic Congestion, and Inefficient Land Use

Challenge	Issues in Cities
Urban Sprawl	Low-density, single-use layouts far from employment hubs
Traffic Congestion	Long commutes due to mono-functional zones and lack of transit alternatives
Inefficient Land Use	Scattered development, vacant land near metro stations, underused parcels
Infrastructure Deficit	Delayed or missing roads, drainage, water supply in outer zones
Social Inequity	Exclusion of lower-income households due to land speculation and gentrification

Table 4-Challenges

2.4 Tools and Indicators

Indicator	Sub-Indicator	Importance	Measurement Method	Units
Population Density	Persons per hectare within station area	Reflects potential transit ridership and demand for services	Total population ÷ developed land area	Persons/Ha
Built-up Density (FSI Usage)	Floor Space Index, % of permissible FSI used	Indicates development intensity around transit	Built-up area ÷ plot area; % of permitted FSI used	FSI value, %
Land Use Mix	Entropy Index / Mix of residential, commercial etc.	Determines functional diversity and self-sufficiency of neighborhood	Entropy formula or land use share ratios within 500m–1km	Index value (0–1)
Accessibility Index	Distance/time to nearest transit & urban centers	Evaluates ease of reaching key destinations via transit	Travel time/distance from origin to station or CBD	Minutes / Km
Mode Share	% using public transport, NMT, IPT, private modes	Shows transit reliance and success of TOD in shifting travel behavior	Household travel survey or secondary data	Percentage (%)
First/Last Mile Connectivity	Sidewalks, cycle lanes, IPT routes, crossings	Indicates quality of access from homes to stations	Physical audit, mapping connectivity gaps	Qualitative/Presence (Yes/No)
Block Size and Street Network	Block length, intersection density	Measures walkability and permeability of local street grid	GIS-based network analysis	Meters, nodes/km²
Travel Time Reduction	Time saved due to transit	Reflects efficiency and attractiveness of transit	Before-after studies; modeled scenarios	Minutes
Land Value Change	% increase in land price post-transit	Indicates potential for Land Value Capture (LVC) mechanisms	Property rate trends within influence zones	₹/m², % change
Infrastructure Availability	Water, roads, sewerage, power	Assesses TOD readiness and development viability	Field survey, ULB data mapping	% coverage, km, capacity
Encroachments & Informality	Street vending, informal housing in station zone	Affects public realm, walkability, and equity	Field audits, satellite imagery, photo documentation	No. of units / % of area
Parking Availability	On-street, off-street parking near stations	Reflects car dependency, street clutter, and TOD enforcement status	Parking inventory survey	Number of bays, sqm
Policy & Zoning Support	Presence of TOD zones, mixed-use permissions	Indicates legal and institutional readiness for TOD	Review of DCR, master plan, TOD overlays	Yes/No, Number of policies

Table 5-Tools and Techniques

3. CASE STUDY

3.1 International Case Studies

3.1.1 Singapore – MRT and Rail + Property Model

Singapore, being a small island city-state with limited land, has attained one of the highest degrees of transit integration through a proactive and centralized planning system. With 80% of its population having walkable access to MRT stations, Singapore is an example of a mature and financially sound TOD system.

Figure 15-Singapore Plan

Figure 14-Singapore Metro

Planning & Institutional Framework:

- Land Transport Authority (LTA) and Urban Redevelopment Authority (URA) work in co-ordination.
- State land ownership enables planned integrated development and planned densification.

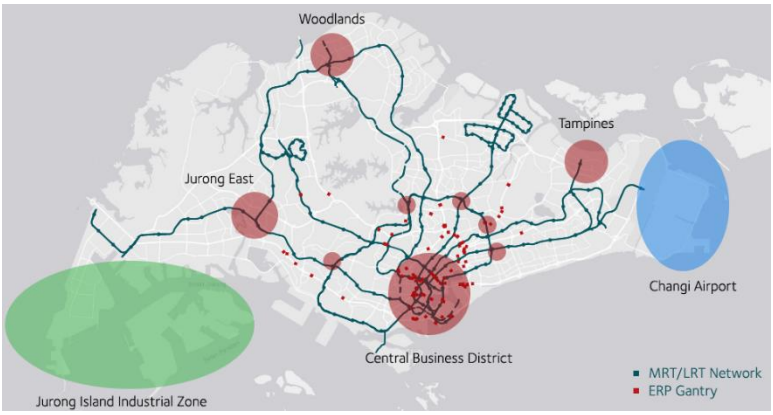


Figure 16-Singapore MRT Key Plan

- "Rail + Property" (R+P) model enables the government to lease land near MRT stations to developers.

TOD Strategies:

- High-density, mixed-use developments incorporated into station buildings directly.
- Restrictive vehicle control (Certificate of Entitlement system) discourages car ownership.
- Public housing constructed above or alongside MRT stations (e.g., Punggol, Bishan).

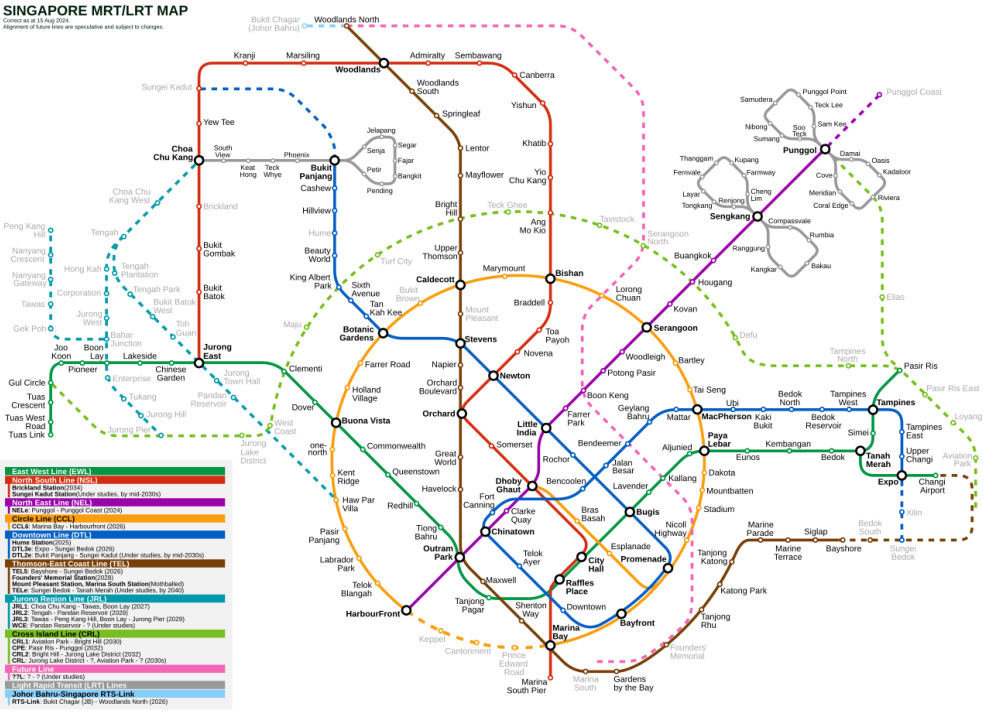


Figure 18-Singapore MRT/LRT Map

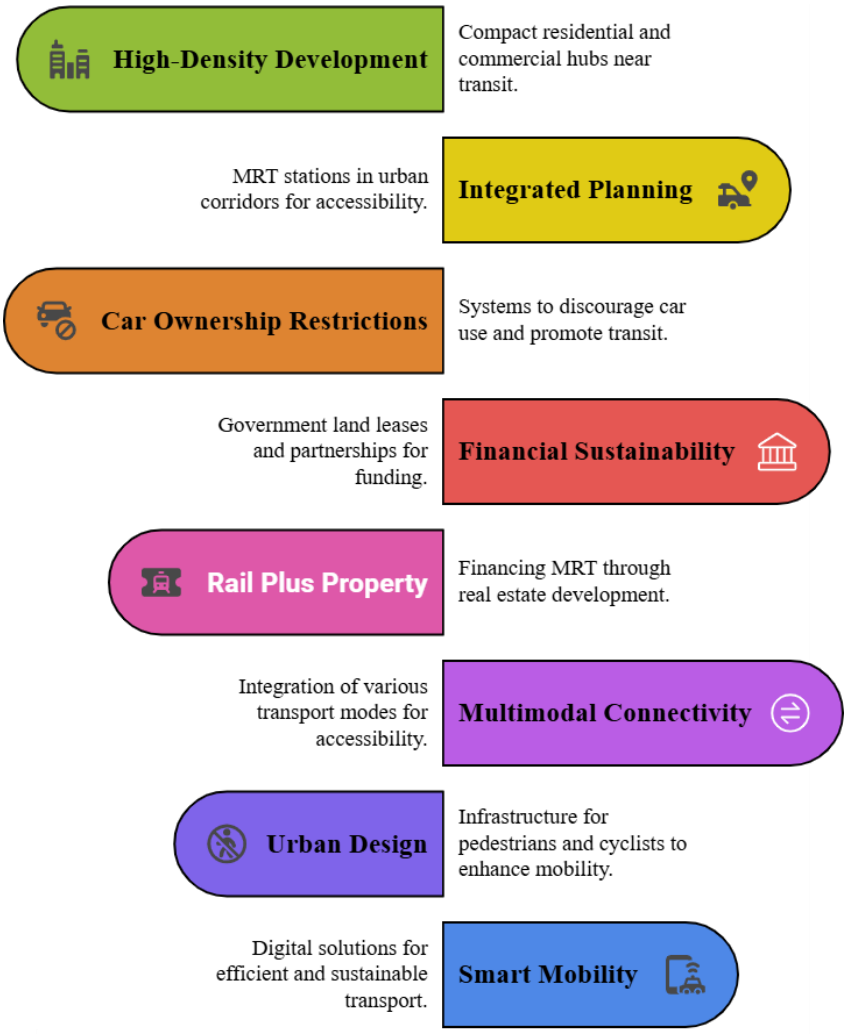

High-Density Development
Compact residential and commercial hubs near transit.
MRT stations in urban corridors for accessibility.
Integrated Planning
Car Ownership Restrictions
Systems to discourage car use and promote transit.
Government land leases and partnerships for funding.
Financial Sustainability
Rail Plus Property
Financing MRT through real estate development.
Integration of various transport modes for accessibility.
Multimodal Connectivity
Urban Design
Infrastructure for pedestrians and cyclists to enhance mobility.
Digital solutions for efficient and sustainable transport.
Smart Mobility

Figure 17-Singapore Key Strategies

Implementation Mechanisms:

Figure 19-Singore Integrated landuse Model

- **Unplanned development along metro corridors.**

  → Regulated with TOD policies and Local Area Plans (LAPs).

- **Low integration of land use–transport planning**

  → Addressed with integrated development control rules and mobility planning.

- **Ragged last-mile and pedestrian experience**

  → Enhanced with multimodal integration, pedestrian paths, skywalks, and NMT infrastructure.

- **Sub-divided land ownership and encroachments**

  → Managed through land readjustment and pooling with stakeholders' coordination.

- **Wasteful use of land around transit infrastructure**

  → Addressed by redefinition of FSI norms and promotion of high-density mixed-use development.

- **Institutional coordination problems**

  → Remedied by the creation of Unified Metropolitan Transport Authorities (UMTAs) and task forces.

Factors Behind the Successful Implementation

- **Government-Leading Planning & Policy Regulation**
  - Planning of land use by the Urban Redevelopment Authority (URA) is coordinated with transport planning.
  - High political leadership towards integrated urban and transport development.

- **Effective Public Transport Network**
  - The MRT network extends to all corners of the city, facilitating high accessibility and low private car dependency.
  - Systems of real-time passenger information ensure efficiency and reliability.
- Land Value Capture as a Financing Model
  - The government owns the property and leases it at premium prices around the MRT stations to finance the development of the metro.
  - Developers are urged to construct mixed-use properties around transit hubs.
- **Sustainability & Livability Focus**
  - Most space-efficient urban compact form.
  - Infrastructure pedestrian- and cyclable-friendly for connection at the last mile.
  - Energy-efficient, green MRT stations.

Results:

- MRT ridership ranks among the world's highest.
- Car ownership decreased to below 11% of all trips made.
- Substantial land value appreciation along MRT lines used to finance additional transit development.

Important Takeaway:

Concentrated land ownership and an effective public-private partnership model (Rail + Property) are TOD success and financial sustainability.

3.1.2 Copenhagen – The Finger Plan

Copenhagen's "Finger Plan," originally drawn up in 1947 and revised across decades, guides urban growth along five S-train corridor suburbs (the "fingers") from a central "palm" of concentrated urbanization.

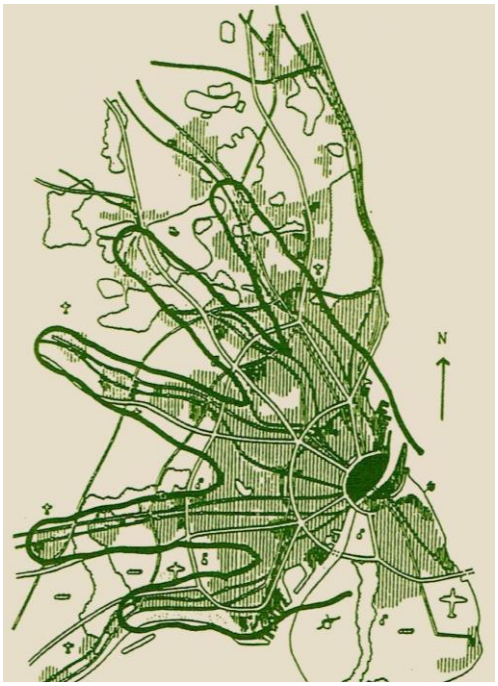


Figure 21-Copenhagen Finger Plan

Planning Strategy:

The plan is to have the city radiate out from a central 'palm' (historic city centre) along five separate corridors, each like a "finger," and aligned parallel with major suburban rail lines. These corridors are used for residential, commercial, and mixed-use development, and the inter-finger spaces are set apart for use as green belts for achieving environmental sustainability and preventing urban sprawl. The hallmark of the plan is its focus on radial, transit-based growth. Urban growth is heavily regulated along transit corridors to provide compactness and high accessibility.

Figure 20-Copenhagen Metro Lines

Figure 22-Copenhagen Metro Network

Copenhagen Metro Lines

- M1 & M2: Connect city center to eastern and western suburbs.
- M3 (City Circle Line): Enhances central Copenhagen's connectivity.
- M4: Extends to northern harbor, supporting new developments.

Copenhagen's Metro network

The M1 and M2 lines link the central city to eastern and western suburbs, whereas the M3 (City Circle Line) facilitates internal connections all over the center of Copenhagen. The recently extended M4 line extends the system to the northern harbor, enabling urban renewal and expansion of new mixed-use precincts.

The Copenhagen example demonstrates how corridor-based long-term planning integration with public transport investment can lead to balanced growth, resource conservation, and dense, sustainable urban form.

Finger Plan and Metro Extension – Copenhagen

- **Transit-Oriented Development:**

The 'fingers' are connected by metro stops, facilitating high-density, mixed-use development, compact urban expansion, and decreasing dependence on the private car. Mixed use development around the stations, with schools, services, and businesses within 500m. Walking and cycling infrastructure given priority through corridors.

- **Sustainable Urban Growth:**

Green belts separating the development corridors are preserved to offer ecological balance and enhance quality of life overall.

- **Improved Public Transport Links:**

Metro extension increases access and is in line with the initial Finger Plan vision by linking the major residential and commercial areas in an efficient manner.

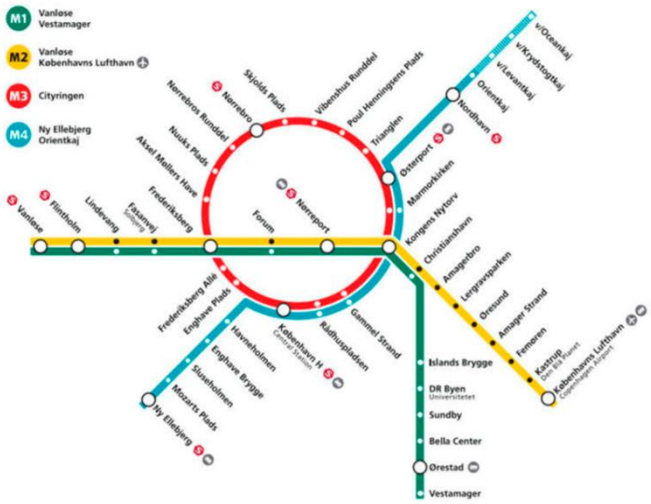


Figure 23-Copenhagen integrated Transit System

- **Integration with Other Transit Systems:**

  - **S-Train Network:** Integration with the S-train of Copenhagen is effortless for Metro, providing smooth transfers and wide urban-suburban coverage.
  - **Buses and Regional Trains:** Metro stops are configured to match city bus routes and regional train runs, providing convenient transfers and multimodal freedom.

Challenges & Solutions

- **Urban Sprawl & Uncontrolled Growth:**

- **Problem:** Urbanisation outside planned corridors.
- **Solution:** Controlled with strict zoning and green belt maintenance to contain development within planned 'fingers'.

- **Resistance to TOD:**

- **Problem:** Land owners and developers restricted intensification from restrictive land use policies.
- **Solution:** Confronted with providing higher FSI and utilizing land value capture instruments to encourage development along transit.

- **Funding & Financial Sustainability:**

- Problem: Metro and TOD infrastructure entailed huge capital expenditures.
- Solution: Addressed through PPPs, congestion charging, realty taxes, and land-based financing mechanisms.

- **Traffic Congestion:**

- Problem: Private vehicle overuse resulted in traffic congestion and pollution.
- Solution: Promoted cycling (cycling facilities), pedestrian flows, and car-free thoroughfares to alleviate traffic loads.

- **Environmental Conservation:**

- Problem: Development against environment preservation.
- Solution: Promoted intensive, mixed-use development combined with urban parks and conserved open space.

Key Strategies in Copenhagen's TOD & Metro Expansion

- **Transit-Oriented Development (TOD):** Mixed use, high-density development along metro corridors to increase public transport coverage.

- **Radial Growth with Green Belts:** Growth in planned areas with green belts to avoid sprawl.
- **Integrated Public** Transport: Easy integration of metro, S-train, and bus with multi-modal integration to minimize car dependency.
- **Land Use Planning & Zoning:** High FSI/FAR around transit locations, land value capture, and stringent zoning for planned growth.
- **Sustainable Urban Development:** Pedestrian- and bicycle-friendly neighbourhoods, green buildings, and smart city projects.

Factors behind the Successful Implementation

1. **Long-Term Perspective & Policy Consistency**- Finger Plan (1947) gave a crystal clear, long-term development plan, which was uniformly implemented.
2. **Strong Institutional Setting**- One vision was followed by government departments, town planners, and transport commissions.
3. **Integration of Land Use & Transport-** Metro and rail corridors were concentrated upon for high-density urbanization with patches of greenery in between.
4. **Eco-Friendly Funding Mechanism-** Land value capture, PPP projects, and real estate taxes ensured financial sustainability of metro expansion.
5. **Public Transport & Non-Motorized Mobility Focus**- Strongly organized public transport system, cycling, and walking network minimized the use of personal vehicles.
6. **Environmental Sustainability**-Conservation of green belt, green architecture, and the use of renewable energy kept the city plan on a low-carbon track.

Outcomes:

- High transit mode share (around 45%).
- Regional density preserved without dependence on cars to a major extent.
- Open space preserved between the corridors.

Key Takeaway: Long-term rail infrastructure-based corridor planning can influence a green sustainable city development and maintain greenspace in an efficient way.

3.1.3 Cape Town, South Africa

Urban development in Cape Town separated poor communities from the economic centres of the city. In an effort to mitigate spatial segregation and promote inclusive urban development, the city implemented a TOD Strategic Framework in 2016.

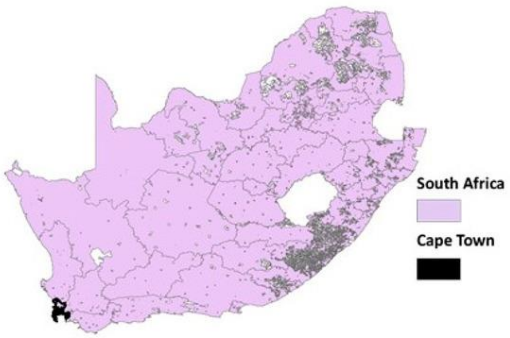


Figure 24-Location of Cape Town

Planning Framework:

- TOD integrated within the Municipal Spatial Development Framework of the city.
- Restructuring focus, equitable access, and inclusive development.

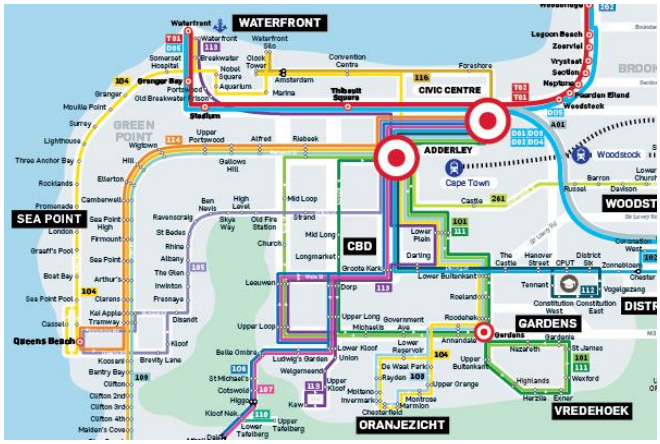


Figure 26-Cape Town integrated Rail Transport

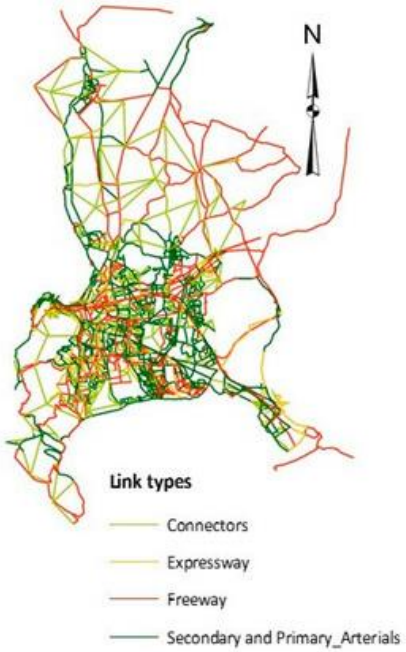


Figure 25- Cape Town Transport Network

TOD Approaches:

- TOD given priority on major corridors: commuter rail, BRT and arterial roads.
- Prioritize safety of pedestrians, generation of employment in the locality and accessible housing.
- Transit Accessible Precincts zoned, offering development incentives.

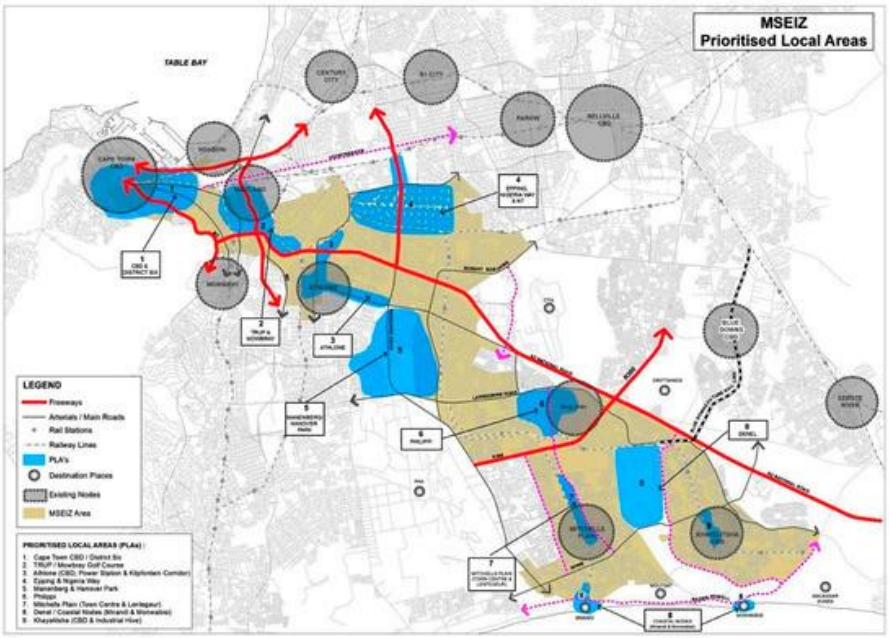


Figure 27-Metro Integration zone in Cape

Implementation Mechanisms:

- Usage of city lands for mixed-income developments.
- Corridor intensification and LAPs drafted.
- Public realm improvements such as sidewalks, public squares, and lighting.

Outcomes:

- Concept is policy-led but restrained due to finance restrictions.
- Pilot initiatives (Wynberg Precinct) show possibilities but require roll-out.

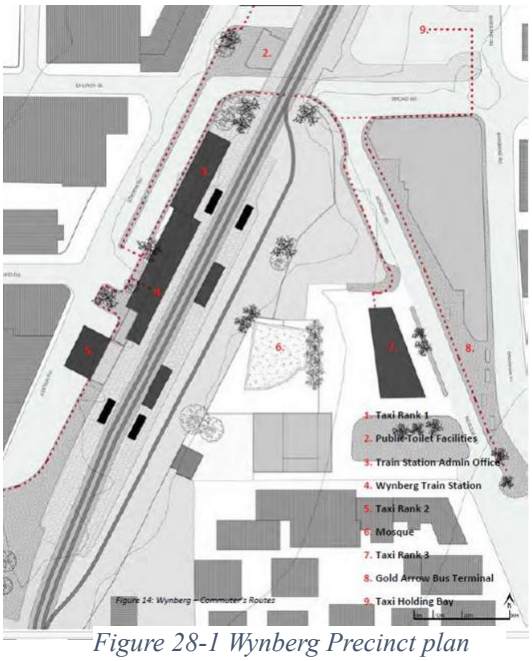

1. Taxi Rank 1
2. Public Toilet Facilities
3. Train Station Admin Office
4. Wynberg Train Station
5. Taxi Rank 2
6. Mosque
7. Taxi Rank 3
8. Gold Arrow Bus Terminal
9. Taxi Holding Bay

Figure 28-1 Wynberg Precinct plan

3.1.3.1 Wynberg Precinct in Cape Town, South Africa.

Redevelopment of Wynberg Precinct according to TOD Principles.

Wynberg Precinct is a key transport interchange in Cape Town with a train station and three lines of taxis. Physical and functional segregation due to the train station caused growth of informal street trading around transport interchanges has generated competition for public space, impacting pedestrians, transport operators, and traders

Key Issues Identified

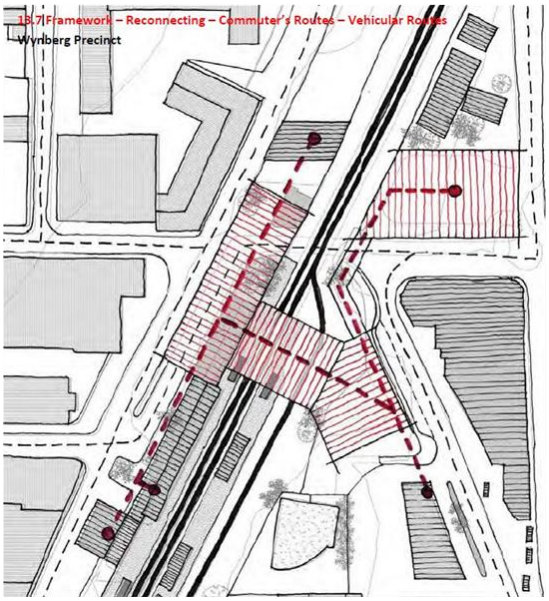


Figure 30 Wynberg Precinct plan

- **Contest for Space in the Precinct**
  - Train station and taxi ranks dominate public space, leaving street traders with no designated area.
  - Pedestrians, traders, and taxis compete for limited space, leading to congestion and conflicts.
- **Infrastructure Gaps for Informal Traders**
  - Lack of designated trading spaces forces traders onto sidewalks and streets.
  - No permanent storage or shelter, making traders vulnerable to weather conditions.
  - Poor sanitation and waste removal, leading to hygiene issues.

Figure 29- Wynberg Precinct Challenges near Station

- **Non-Integrated Pedestrian Footpaths & Inadequate Access**
  - Train station, taxi stands, and bazaars are not integrated.
  - Pedestrians have to use the road because of narrow footpaths.
  - The underpass is automobile-oriented, hence not pedestrian-friendly.
- **Public Space & Transit-Oriented Design (TOD) Requirements:**
  - The public space does not have open areas promoting street life.
  - The transport interchanges are multi-modal and non-transit oriented.
  - There is no properly conceived scheme for sustainable urban development.

Redevelopment Solutions

Figure 151: Tr

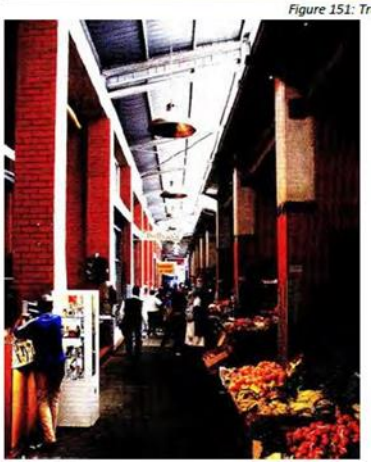


Figure 31-Traders Stall

- **Traders Zones:** Incorporate well-planned trader zones with transit facilities within them.
- **Balanced Street Design:** Preserve open pedestrian pathways, ensure clear taxi, bus, and trader routes to avoid collisions.
- **Permanent Trading Stalls:** Create neatly planned market spaces with shelter, storage, and sanitation for spontaneous traders.
- **Integrated Waste Management:** Include waste bins, sanitary areas, and sufficient cleaning services for traders.
- **Pedestrian-Friendly Connectivity:** Suggest the underpass to enable secure pedestrian movement.
- **New Pedestrian Connections and Crossings:** Incorporate skywalks, pedestrian walkways, and cycling lanes for easy connectivity between transit hubs.

Figure 32-Pedestrian Connections and Crossings & Underpass

- **Place making Programs:** Incorporate parks, public spaces, and rest stops for a livable transit campus.
- **Apply TOD Principles:** Apply walkable, mixed-use city design to facilitate transit, neighbourhood shopping, and commuters in an efficient use of time.

Key Takeaways Project

- Evaluate pedestrian connectivity & the last-mile connectivity around constructed metro stations.
- Designate areas where informal traders can be allocated around metro extensions to prevent congestion.
- Enhance accessibility with better urban planning (bridges, pedestrian walkways, and TOD integration).
- Implement transit-oriented & place making strategies to build active, green urban culture.

3.1.4 Dhaka, Bangladesh

Dhaka is the fastest-growing city in the world with severe traffic jams, urban sprawl, and air pollution. The Dhaka Metro is designed to enhance public transport convenience and reduce dependency on private vehicles. Agargaon Metro Station is an important component of the Dhaka Metro but is not yet well incorporated into the urban context.

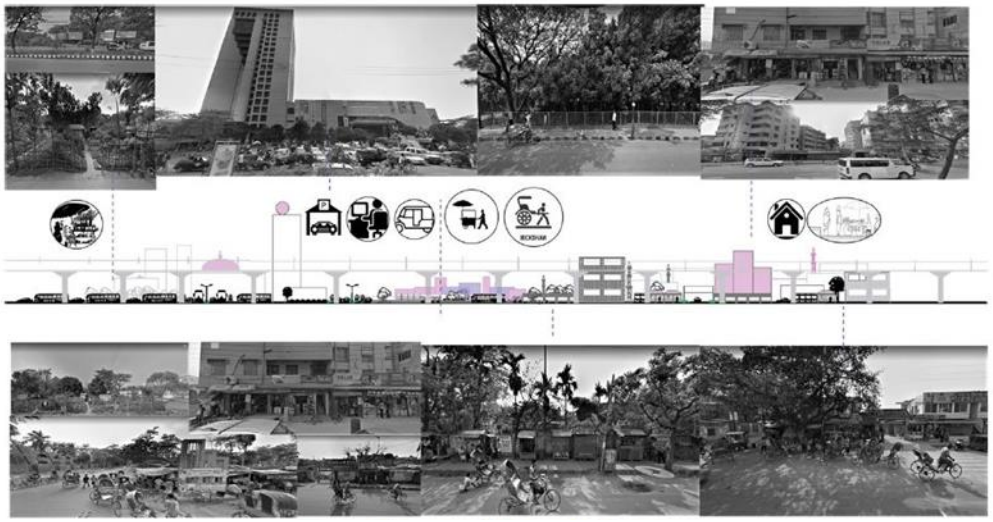


Figure 33-Agargaon Metro Station

Key Challenges Identified

- **Lack of Pedestrian Infrastructure-**Inadequate footpaths, unsafe crossings, and street vendor encroachments.
- **Fragmented Land Use-**Inadequate mixed use development—surrounding land use.

- **Car Dependency-**Overspending on private car use due to lack of adequate public transport integration.
- **Weak Multi-Modal Connectivity-** Lack of adequate bus feeder system to support last-mile connectivity.
- **Informal Settlements & Vendors-** Vendor encroachments in the surrounding area near the station causing congestion and decreased accessibility.
- **Limited Green & Public Spaces-** Inadequate parks, plazas, making the location less pedestrian-friendly.

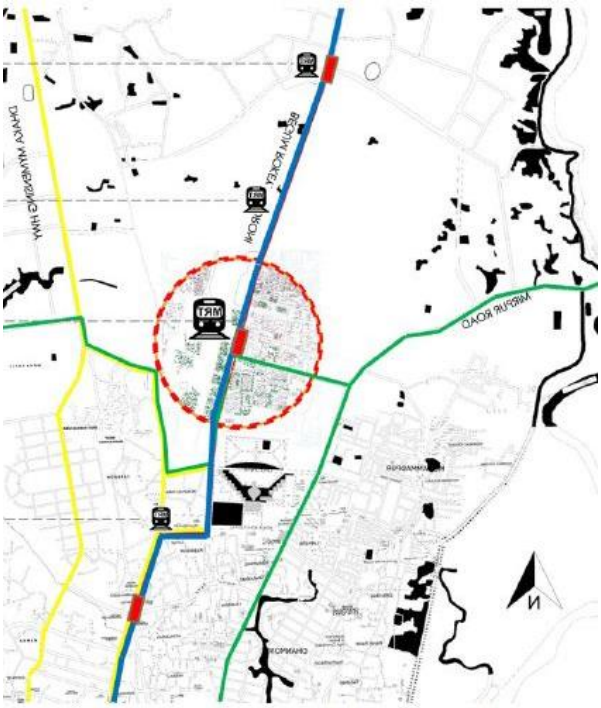


Figure 34-Agargaon Metro Station Location Key Plan

- **Coordination Issues Between Agencies**-Inadequate coordination between urban planners, transport agencies.

Strategies & Approaches for TOD Implementation

- **Enhance Pedestrian and Cycling Facilities-**Widen sidewalks, add specialized bike lanes, and add pedestrian crossings.
- **Implement Mixed-**Use Zoning Policies-Encourage residential, commercial, and retail establishments within 800m of the station.
- **Enhance Multi-Modal Connectivity-**Add feeder bus services, integration with ride-sharing schemes, and bicycle-sharing schemes.
- **Develop Public Spaces & Plazas-**Construct green spaces, pedestrianized streets, and transit plazas to attract foot traffic.
- **Institutionalize Vendor Zones-**Special market zones should be demarcated so as not to cause congestion.
- **Coordinate Policy & Governance-**Create a task force with TOD-focus involving urban planners, government bodies, and private developers.

3.2 Indian Case Studies

3.2.1 Delhi Metro

Figure 35-Metro Network

The Delhi Metro Rail Corporation (DMRC) has been a game-changer in India's capital, revolutionizing city mobility since it was formed in 2002. With over 390 kilometres of track operating and over 285 stations, the Delhi Metro is not only one of the largest but also one of the busiest urban transit systems globally. It is renowned for its success in reducing traffic jams, improving air quality, and offering efficient public transport, and it played an instrumental role in making it a template for other Indian cities.

Realizing the potential of the metros as an instrument of organized urban development, the Government of NCT of Delhi and Delhi Development Authority (DDA) commissioned a comprehensive Transit-Oriented Development (TOD) Policy in 2015. To transform urban development along transit corridors in order to provide compact, mixed-use, pedestrian-oriented neighbourhoods.

Policy Framework

- Delhi TOD policy places a 500-meter impact area on both sides of the MRTS corridors (metro and high-capacity public transit). Policy goals are:
- High-density development to maximize land use near transit.

Figure 36-Delhi TOD Zone

- Mixed-use zoning to minimize trip lengths and enhance accessibility.
- Provisions for affordable housing to provide equity.
- Non-Motorized Transport (NMT) infrastructure and enhanced public realm.
- Land Value Capture (LVC) mechanisms to support infrastructure financing.

The Karkardooma Pilot Project was selected as Delhi's first TOD demonstration zone.

Key Features of Delhi TOD Policy

Parameter	Delhi TOD Specification
Influence Zone	500m on either side of metro corridors
Floor Area Ratio (FAR/FSI)	Up to 4.0 (compared to 1.2–2.5 in other areas)
Minimum Site Area	1 hectare for private TOD zones
Land Use	Mandatory mixed-use (minimum 30% residential, 10% commercial)
Affordable Housing	Minimum 20% of residential floor area in each TOD zone
Parking Norms	Reduced parking requirements; focus on NMT and shared mobility
Public Realm	Enhanced walkways, vending zones, green buffers, and street furniture

Table 6-Delhi TOD Policy

Metro Network Impact

Delhi's metro network, combined with robust TOD policies, has had a significant impact on land use. Policies such as increased FSI and mixed-use zoning along metro corridors have aided compact, high-density urban growth.

Station area development has led to significant changes, including a shift from low-rise to high-rise structures in the residential sector and commercial transformation in the 0-250m zone, characterized by commercial corridor development and maximum FAR utilization, resulting in increased property values. The 250-500m zone has seen mixed-use development with higher residential density and the addition of commercial spaces.

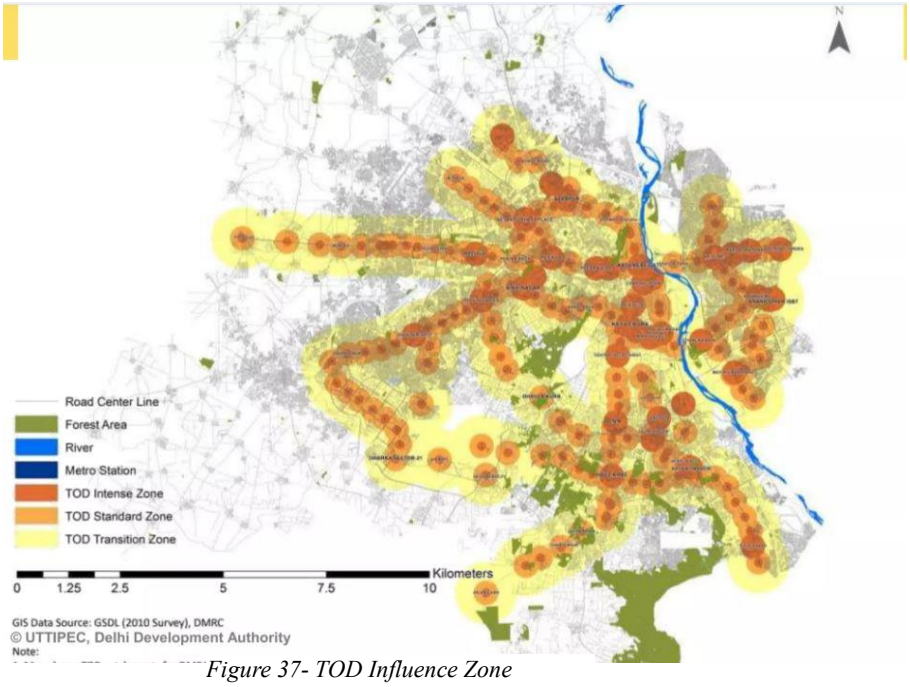


Figure 37- TOD Influence Zone

Land Use Changes:

Residential: Increased densification near metro stations such as Dwarka and Rohini; high-rise housing developments cater to a wide range of income levels.

Commercial: The expansion of mixed-use developments along metro lines, particularly in Nehru Place and Saket.

Green Spaces: TOD zones include public parks, such as Green Spine at INA Metro Station.

Observation -Significant shift towards mixed-use and residential developments. Transportation infrastructure driving land use changes. Decentralization of urban activities. Increased urban density around transit corridors.

Distance from Station	Primary Change	Intensity of Change
0-250m	Commercial	Very High
250-500m	Mixed-Use	High
500-1000m	Residential	Moderate
>1000m	Minimal	Low

Table 7- TOD distance

Zone Type	Permitted FAR	Land Use
TOD Zone	4.0	Mix use
Metro	3.0	Commercial
Non-TOD	2.0	Residential

Table 8-FSI

3.2.1.1 Delhi – TOD Policy and Karkardooma Pilot

Metropolitan expansion of Delhi at a fast pace gave the opportunities to direct development by employing a TOD policy. Delhi 2015 TOD Policy demarcated metro corridors and delineated influence areas for planned densification. In East Delhi, Karkardooma was selected due to its accessibility along two metro corridors and presence of large DDA-owned vacant land parcels.

Planning Framework:

- Demarcated TOD influence area as 500m either side of MRT corridors.
- Multipurpose transport, transit-oriented planning for metro station, bus stop, and commercial hub.
- FSI of 4 with high-rise residential office and tower.
- Street activation by vending spaces and covered walkways.
- Utilization of PPP model for project development through private builders.

TOD Approaches:

- Minimum 30% land reserved for residential purposes; 20% for low-cost housing.
- NMT infrastructure like footpaths, cycle tracks, and vending areas.

OVERALL VIEW
DETAIL BLOCK VIEW
MASTER PLAN
SITE DETAIL
Area of the Site 30 hac.
Gross FAR 1.9
Total Built up area 57 hac.
Land Area Distribution
Area under Mixed use pocket 16.6 hac.
Area under Open space 6.1 hac.
Area under Roads 5.3 hac.
Area under Pathways 2.0 hac.

Figure 38- Karkardooma Project Planing

Implementation Mechanisms:

- Land pooling tried for consolidation of fragmented plots.
- Urban Design Guidelines drafted for station areas.

Outcomes:

Figure 39- Karkardooma Project view

- TOD has been integrated into Delhi's Master Plan 2041 and future urban growth strategies.
- DDA has notified multiple TOD corridors beyond Karkardooma. (e.g., Mayur Vihar, Dwarka).
- Policy has created a framework for densification without sprawl, emphasizing vertical growth and mixed-use zoning.

Challenges:

- Lack of coordination among DMRC, DDA, and MCD resulted in delay in clearances.
- Low off-take by private builders in the early years.
- Enforcement measures and retention of affordable housing took a backseat.
- Slow progress in implementing complete street design and NMT networks.
- Overall adoption restricted due to opposition from landowners, legal issues, and absence of private participation.

TOD Implementation Key Takeaway:

- **Policy-Based Planning is Critical**: A formal policy on TOD gives procedural and legal certainty to authorities and developers.
- **Land Consolidation Mechanisms are Critical:** It is based on the capacity to consolidate fragmented land holdings and release mass development.
- **Integrated Mobility Planning is Critical:** TOD must integrate bus corridors, auto stops, cycle grids, and pedestrian networks.
- **Improvements to the Public Realm Drive Success:** Streetscapes, public spaces, and active edges are crucial to create people-friendly precincts.
- **Community Engagement is Critical:** Early resident and landowner participation can minimize resistance and maximize support for TOD reform.

3.2 Bangalore, India

The "Silicon Valley of India," Bengaluru, witnessed rapid urban growth, population expansion, and spatial sprawl in the last two decades. As traffic congestion, commute times, and environmental degradation grew, it started the Bangalore Metro (Namma Metro) project in 2011 to offer large-capacity public transport. By 2024, the metro network covered more than 70 kilometers, covering major employment, residential, and institutional nodes.

In spite of the potential to prioritize city growth with transit, Bengaluru has not yet enacted a specific TOD policy but there have been attempts to achieve that through reforms in planning, station area development, and FAR-based incentives.

Phases of Growth &Transport

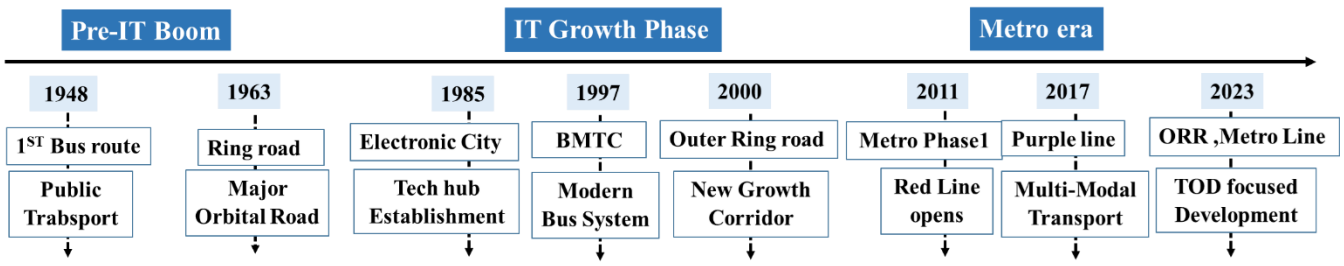


Figure 40-Phases of Growth

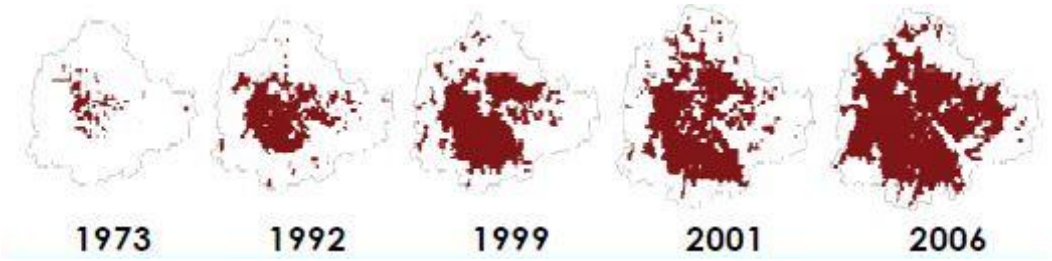


Figure 41-Spatial Evolution

Transit Infrastructure and Growth Impact

- Namma Metro Phase 1 lines (Purple Line & Green Line) pass through high-density, high-demand locations such as MG Road, Majestic, Indiranagar, and Peenya.
- The impact of the metro is reflected in high land prices, redevelopment along business strips, and high-density residential development along target corridors.
- The catchment areas for the metro, however, are still unevenly developed with poor land use integration, poor NMT infrastructure, and little mixed-use planning.

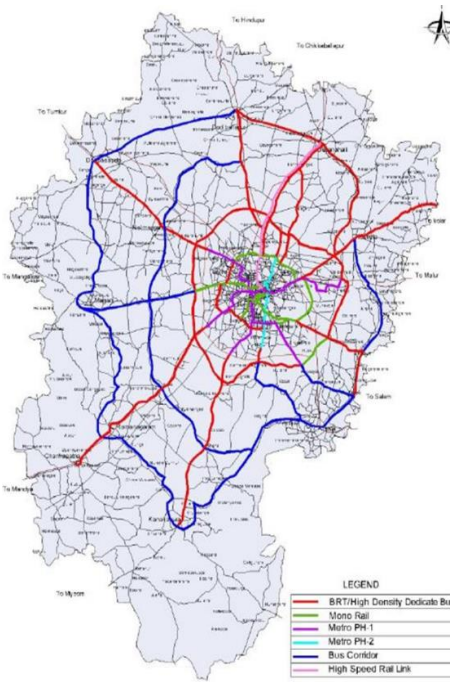


Figure 42-Transit Route Map

Metro Systems

- Phase 1 -East–West Purple Line
- North–South lines. Green Line
- Phase 2 extends existing lines and two new lines
- Namma Metro has influenced land use.
- Commercial development around major stations (e.g., MG Road, Indiranagar)
- Higher FAR along metro corridors.
- Property values (East-West corridor) increased by 25-30%

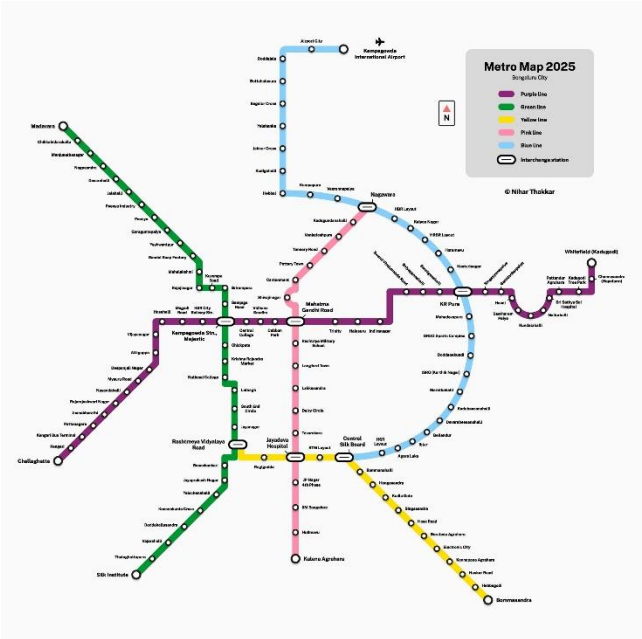


Figure 43-Metro map

Planning Initiatives & Existing Framework:

Aspect	Details
Planning Authority	BMRCL (Metro), BDA (Land Use), BBMP (Municipal), DULT (Mobility Planning)
TOD Policy	No city-wide TOD policy officially notified
Development Plan Strategy	Revised Master Plan (RMP) 2031 proposes higher FAR along metro corridors
Floor Area Ratio (FAR)	Relaxed in select metro corridors from 2.5 to 4.0
Pilot Projects	MG Road, Indiranagar, Majestic – focus on station area improvement
Funding Mechanisms	Limited Land Value Capture (LVC); no formal TOD-based PPP model yet

TOD Approaches:

- Commercial redevelopment linked to metro (e.g., MG Road, Indiranagar).
- Involuntary zoning relaxation for mixed use on an informal basis.
- **Multimodal Integration** involves offering seamless connectivity between buses, metros, and intermediate public transportation systems (such as auto-rickshaws) via designated intermodal interchanges and feeder services.
- **Transit-Oriented Development (TOD):** Increasing density and mixed land use near metros and transport hubs to reduce reliance on private vehicles and long-distance commuting.
- **Inter-modal Interchanges**: The creation of major transportation hubs where various modes of transportation, such as buses, metros, and commuter rail systems, come together to improve urban mobility.

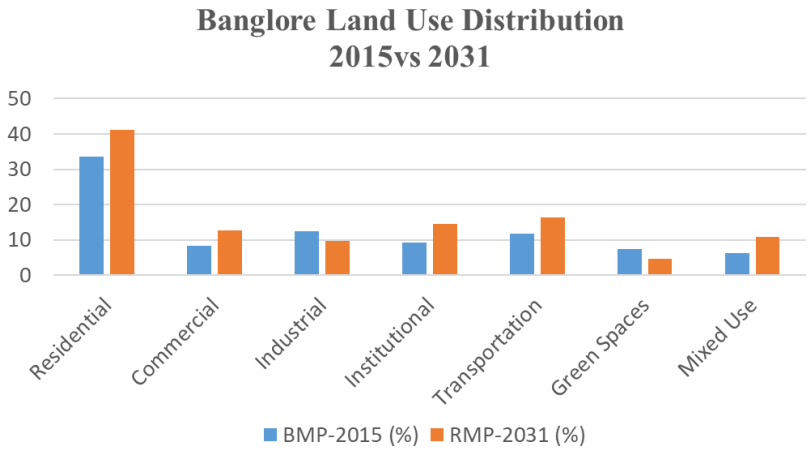
Challenges with TOD Implementation

- **Institutional Jurisdiction Fragmentation:** There is no coordination among DULT, BBMP, BDA, and BMRCL resulting in policy overlap and delay.
- **Land Use Zoning Inflexibility:** Current zoning rules are not adaptable to mixed use convenience or vertical densification near stations
- **Adequate First/Last Mile Connectivity:** There are very few footpaths, skywalks, cycling tracks, or feeder bus routes available at stations, restricting connectivity for passengers.

- **Market-Led Development-** TOD outcomes are themselves more of real estate speculation than policy, and the resulting unequal transformation (e.g., luxury malls vs. non-existent low-cost housing).

Transportation-Induced Land Use Changes

The Namma Metro project has been instrumental in promoting integrated land use and transportation planning in Bengaluru. The city's Revised Master Plan (RMP) 2015 promotes Transit-Oriented Development (TOD) near metro stations in order to maximise land use and improve urban mobility.



Land Use	BMP 2015	RMP 2031
Residential	33.5	41.2
Commercial	8.3	12.7
Industrial	12.5	9.8
Institutional	9.2	14.5
Transportation	11.8	16.3
Green Spaces	7.5	4.6
Mixed Use	6.2	10.9

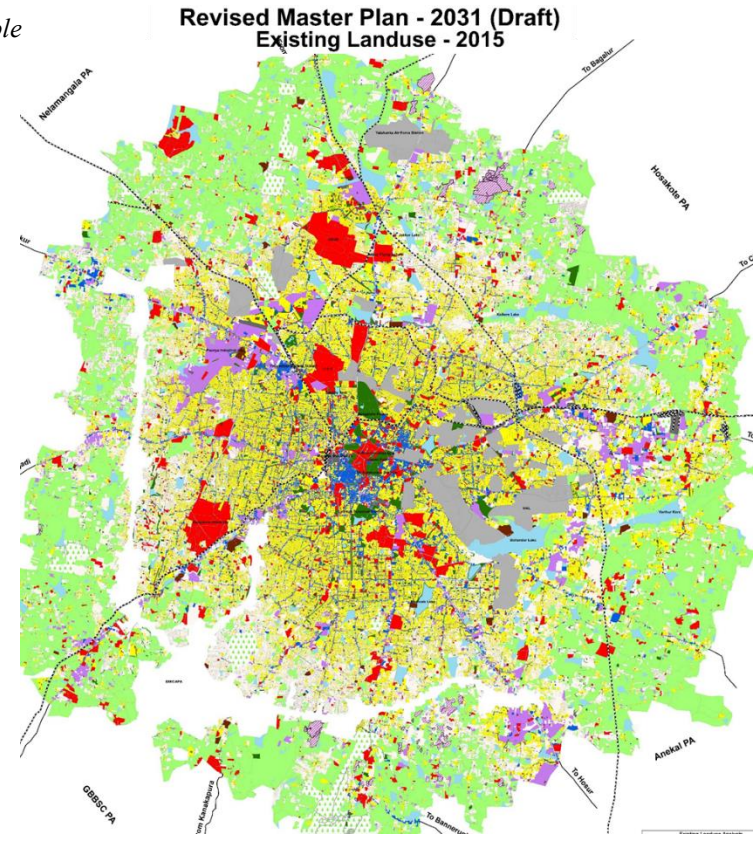
Figure 44-Land use distribution Graph & Table

Land Use Changes:

Residential: Vertical expansion in suburban areas such as Electronic City, Hebbal, and Kengeri.

Commercial: Increased office and retail space near metro stations (Whitefield, Yeshwantpur).

Industrial: Conversion of the Peenya Industrial Area into mixed-use and commercial hubs.



MAP 1-Land use plan Bangalore 2015

Key observations- Significant increase rise in Residential, Mixed Use and commercial Land & Transportation Infrastructure is observed. Industrial Land & Green Spaces has been Declined.

Land Use Changes Due to Transportation			
Changes	**Location**	**Reason**	**Impact**
Commercial and Mixed-Use Shifts	Metro corridors	• Connectivity • Land values,	Low-density residential to commercial & mixed-use
Residential and Vertical Growth	along metro and BRTS, ORR	• Higher FSI Transport Access	Densification transit hubs ,Reduce suburban sprawl
Industrial to Commercial Transformation	Industrial zones	• Connectivity • High land values	Transformation into commercial and mixed-use developments.
Development of Green Spaces, Public Amenities	Near metro & transit corridors	TOD principles promote green spaces	Increased parks and green spaces . Enhance quality of life.

Figure 45- Land use Changes due to Transportation

3.2.3.2 Reasons for Land Use Changes

The expansion of the IT/ITES sector has created jobs and increased demand for office space, resulting in extensive real estate development centred on commercial projects, residential demand, and mixed-use developments. Policies that encourage higher FSI and mixed-use zoning, as well as improved accessibility, have aided the growth of high-value land uses such as commercial and mixed-use developments.

Zone Type	Permitted FAR	Land Use
Metro Station	4.0	Mix use
IT Corridor	3.5	Commercial
ORR	3.0	Commercial
CBD Areas	4.0	Commercial

Table 9- FSI

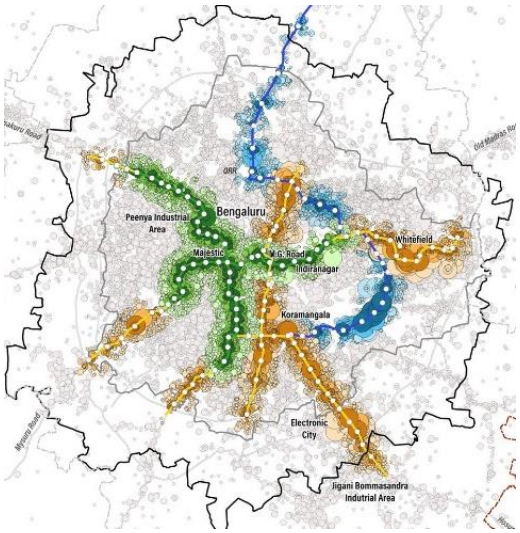


Figure 46- TOD Zone

3.2.3.3 Key Transformation Zones due to TOD

A] Metro Corridors

- Increased FAR up to 4.0
- Mixed-use development within 150m
- Transit-oriented development nodes
- Commercial intensification

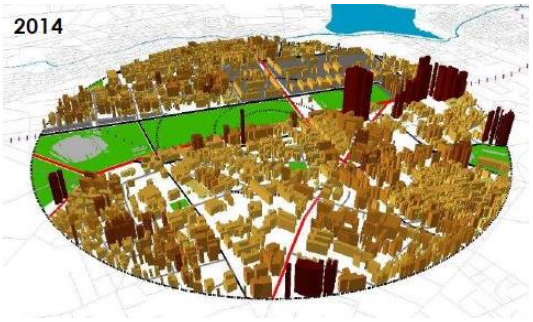


Figure 47- Changes due to FSI

B] Metro Station

MG Road Station (CBD Zone)

- Developed as commercial hub with malls, high-rise offices, and restaurants.
- Less open space and no NMT integration in a formal sense.
- Development led by private investment without any LAP or TOD regulations.

Indira Nagar Station (Mixed-Use Zone)

- Famous for conversion of residences to commerce.
- Metro connectivity spurred boutique shopping, coffee culture, and office space.
- Improvement of streetscape tried but encroachments continue.

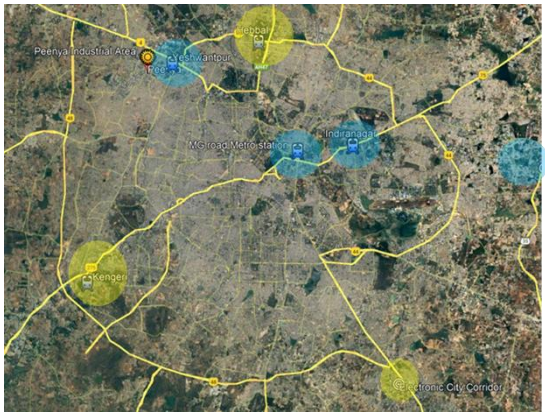


Figure 48- Key Areas

Majestic Interchange (Transit Hub)

- Most integrative modal interchange (Metro + Bus + Rail).
- High pedestrian volumes but disorganized pedestrian flow.
- No integrated urban planning or station precinct planning.

Whitefield-ITPL Corridor	
Before (2011)	**After (2031 Projection)**
•Low-density residential •Agricultural land •Scattered industrial units	•IT/ITES SEZs •High-rise apartments •Mixed-use developments •Metro connectivity

Electronic City Corridor	
Before (2011)	**After (2031 Projection)**
•Industrial areas •Vacant lands •Rural settlements	•Tech parks •Residential townships •Commercial centers •Enhanced connectivity

Table 10- Corridor Transformation

Land Use Distribution Changes			
Landuse	**Changes**	**Impact**	**Metro Station**
Residential Land	Increased density with **vertical developments** near transit hubs	Mixed-use residential develop, combining affordable housing and commercial spaces.	Electronic City, Hebbal, and Kengeri
Commercial Land	commercial growth around transit hubs,CBD	Growth in mixed-use due to accessibility.	Whitefield, Yeshwantpur Indiranagar
Industrial Land	Decline in central industrial areas shift to commercial & mixeduse	Re-zoning of industrial zones to commercial uses due to better transport connectivity.	Peenya Industrial Area
Public & Green Spaces	Space for parks and green spaces corridors.	recreational spaces, promoting sustainability and walkability.	MG road Metro station

Table 11-Land Use Distribution Changes

Land Value

- Pre-Metro Period (2002–2011): 8–12% annual appreciation.
- Phase 1 Construction and Operation (2011–2017): 20–30% increase within 500m.
- During the early impact period (2017-2020), property values within 1km of operational metro stations increased by 15-25%.

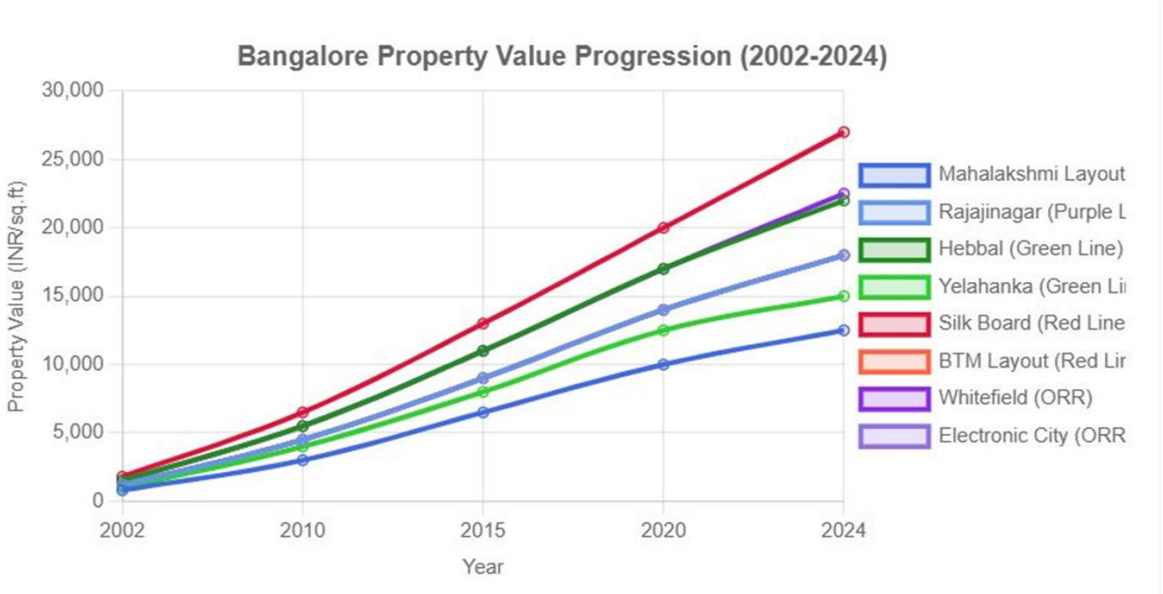


Table 13-Land Value Graph along TOD corridors

- Recent Trends (2020-2024): A 25-40% increase within three years. Peripheral Areas: The highest value increase.
- Tech Corridors: Peak appreciation (Whitefield, Electronic City).
- Highways/Ring Roads: Significant expansion.

- Residential: 10-15% increase near stations.
- Commercial: High demand near metropolitan hubs.
- Maximum increase in property value at Halasuru Metro station.

Key Takeaways and Best Practices

- **Need for Integrated Planning:** City needs a well-synchronized TOD framework that combines land use, mobility, and urban design.
- **Role of DULT and BMRCL:** Agencies are required to co-develop LAPs and TOD overlays in strategic nodes with clear zoning elasticity.
- **Incentives & LVC:** Premium FAR concepts and development impact fees can fund local infrastructure and public space upgrades.
- **Public Realm First:** Inclusive growth can be assured through quality footpaths, green buffers, and open spaces.
- **Pilot LAPs:** Preparation of Local Area Plans node-wise at interchange stations can demonstrate TOD value (e.g., Silk Board, Hebbal, Whitefield).

Inference

- The city's IT sector drives rapid growth, creating a high demand for mixed-use and transit-accessible developments.
- Built Form Densification: Vertical expansion caused by high demand for commercial space, scarcity of land, and FSI use near transit hubs.
- Urban Form and Density: Linear development along key corridors (Outer Ring Road and Hosur Road)
- Peri-urban expansion is a result of improved connectivity, which contributes to sprawl.

Key Takeaway:

Without a formal TOD policy, metro-driven growth is spread out, market-driven, and exclusionary. Planning must be supported by policy and tied to LAPs.

3.3 Ahmedabad, India

The state capital of Gujarat, Ahmedabad, has led the way for India's transit-oriented development with its Janmarg Bus Rapid Transit System (BRTS) and more recently the Ahmedabad Metro. Ahmedabad, in its ambitious urban planning approach, builds on TOD principles with the first Indian city to include TOD principles in its Development Plan and adopt corridor-level Local Area Plans (LAPs). Ahmedabad's institutional vision is a first in utilizing statutory tools to enact TOD.

Phases of Growth &Transport

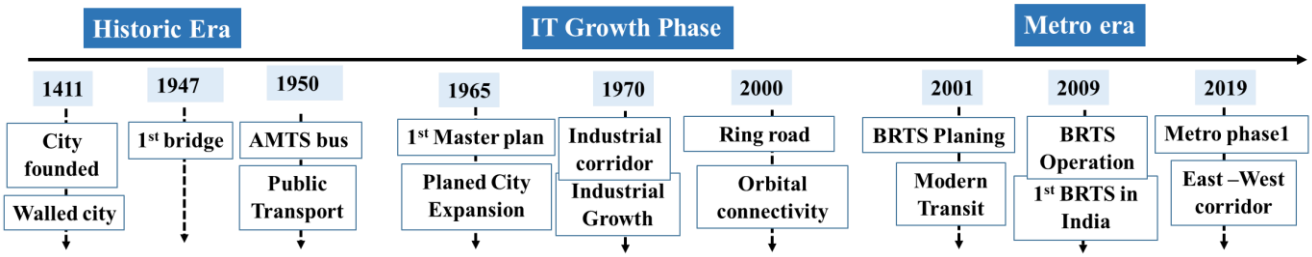


Figure 49-Phases of Growth &Transport

Key features:

- **Dedicated BRTS Lanes:** The BRTS has dedicated lanes that ensure timely and efficient public transport, reducing the need for private vehicles. This has helped to reduce traffic congestion in key areas of the city.
- **Mixed-Use Zoning:** The BRTS corridors have been designated as mixed-use zones. These areas encourage higher-density developments that mix residential, commercial, and recreational uses. This reduces the need for lengthy commutes and promotes compact urban development.
- **Affordable and Accessible Transit:** The BRTS serves a large portion of Ahmedabad's population, which contributes to its success and increased public transportation usage.

Transport Infrastructure and Policy

Janmarg BRTS: In operation since 2009, spans more than 100 km with bus ways.

Ahmedabad Metro (Phase 1): Commenced in 2019; operational along 40+ km East-West and North-South corridors.

Planning Authority: Ahmedabad Urban Development Authority (AUDA), Ahmedabad Municipal Corporation (AMC), and CEPT University as a technical advisor.

Planning Approach

- City Development Plan and Development Plan (2021) had identified TOD corridors.
- Metro, BRTS, and city buses integrated as a multimodal plan.
- Brownfield redevelopment, land consolidation, and LAPs were targeted.

Integration strategies:

- **Strategic Alignment of BRTS Corridors:** The BRTS routes were aligned with key urban growth areas to promote development along the corridors. Zoning regulations changed to encourage higher density and mixed-use development near BRT stations.
- **Multi-Modal Connectivity: The** BRTS integrates with other modes of transportation such as local buses, auto-rickshaws, and the planned metro network, providing seamless connectivity and expanding the city's multi-modal transportation options.
- **Ahmedabad uses the Town Planning Scheme (TPS)** -This scheme reorganises land holdings, provides necessary infrastructure, and ensures equitable development. It helps to integrate land use and transportation planning by encouraging denser, more sustainable urban forms near BRT corridors.

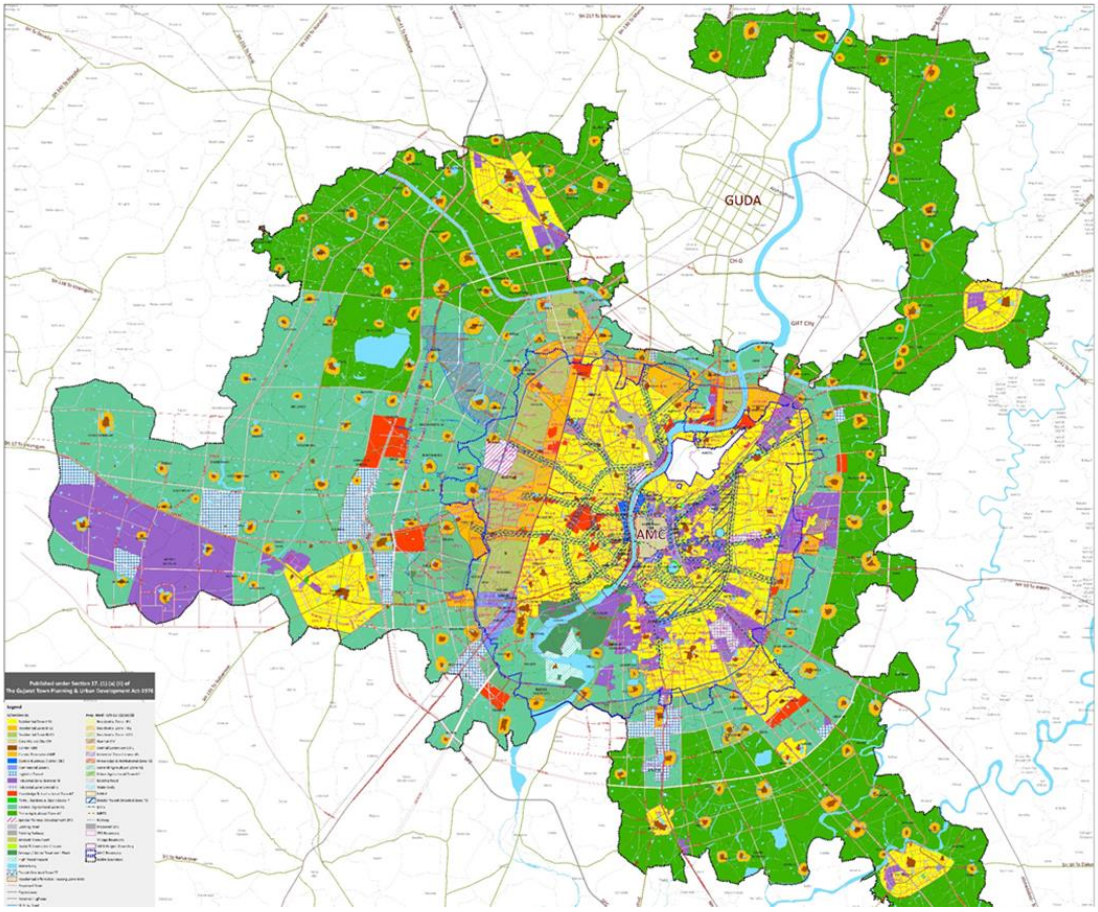
TOD Policy Framework:

Aspect	**Details**
TOD Zones	Defined as 200m–500m buffer around BRTS and Metro corridors
TOD Tools Used	LAPs, Town Planning Schemes, Form-Based Codes
Floor Space Index (FSI)	Enhanced FSI up to 4.0 along BRTS/Metro routes
Mixed Use Policy	Permitted across TOD zones; includes commercial, residential, and civic
Affordable Housing	Incentivized within TOD zones; mix of typologies ensured
Land Value Capture (LVC)	Premium FSI, Betterment Charges, Land Reconstitution (TP Schemes)

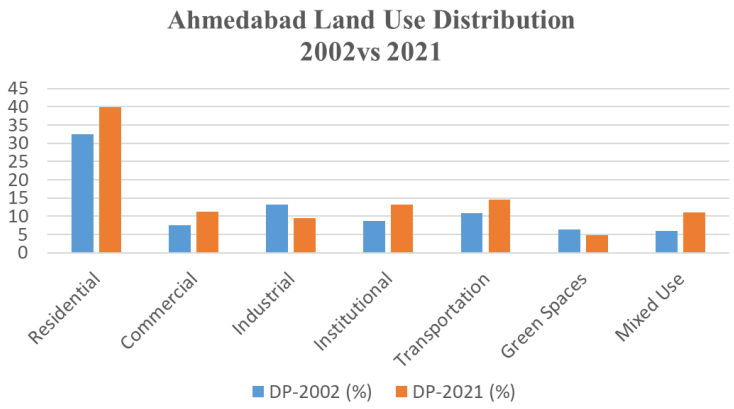
Implementation Mechanisms:

- CEPT University prepared TOD Policy Guidelines in 2015 with support from MoHUA.
- AMC implemented TOD by way of Local Area Plans for central locations
- Town Planning Schemes (TPS) utilized for banking land and reallocating for transit use.
- Walkability, mixed land use, and high-density corridors given utmost importance.

Land Use Changes



MAP 2-Land use plan Ahmedabad 2021



Land Use	DP-2002	DP-2021
Residential	32.5	39.8
Commercial	7.5	11.2
Industrial	13.2	9.5
Institutional	8.7	13.1
Transportation	10.9	14.6
Green Spaces	6.3	4.8
Mixed Use	5.9	11.0

Figure 51-Land use distribution Ahmedabad

Land Use Changes

- **Commercial Growth:** Transportation corridors such as BRTS and metro lines have accelerated the development of commercial activities and hubs by improving accessibility and increasing land values, attracting shops and businesses. This has resulted in commercial and mixed-use development.
- **Residential Transformation:** Metro and BRTS corridors, as well as ring roads, have increased residential density through vertical growth and integrated townships, due to higher FSI and affordable housing policies, resulting in urban densification.
- **Industrial Relocation:** Industrial zones have moved to the outskirts, while inner-city industrial zones have been converted to mixed-use developments due to improved accessibility and high land values, resulting in rezoned commercial and mixed-use.
- **Key Observation**- Increase rise in **Residential, Mixed Use and commercial Land** & Transportation Infrastructure is observed. Industrial Land & Green Spaces has declined.

Reasons for Land Use Changes

- Land Values: Increased connectivity.
- Accessibility: shorter travel time due to transit connectivity.
- Policy incentives include high FSI and zoning policies.
- Economic Opportunities: Attracts businesses, driving demand for commercial space.

Urban Form and Density

- Riverfront Development: The Sabarmati project reshaped urban form and increased density.
- BRTS Corridor: Increased densification and mixed-use along the corridors.
- Riverfront Impact: Improved spaces, but displaced some communities.

Zone Type	BASE	Land Use
CBD	1.8 -5.4	Commercial
R1&R2	1.2-1.8	Mixed Use
TOD Zone	3.0-4.0	Mixed Use
Non-TOD	2.7	Residential

Table 14- FSI

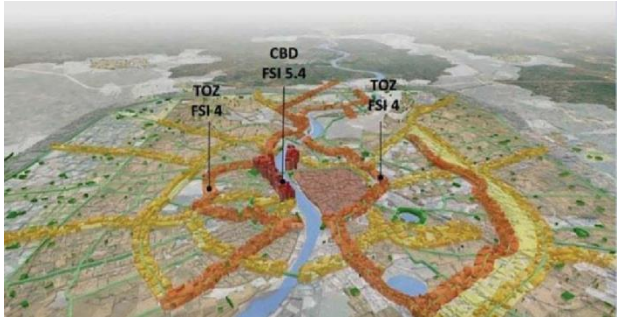


Figure 52- FSI Ahmedabad

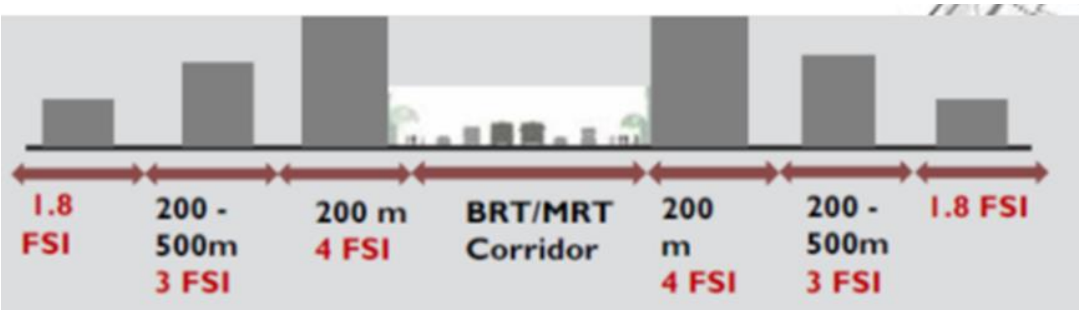


Figure 53- Urban Form

Challenges

- Peripheral Metro/BRT corridors remain unfinished TOD readiness due to plot fragmentation.
- Car ownership patterns and parking demand constrain actual modal shift.
- Affordable housing take-up in TOD areas continues to be subdued.

Corridor Development	
Before (2011)	**After (2031 Projection)**
• Low-density residential • Scattered commercial development • Large agricultural parcels	• Mixed-use developments • Commercial intensification • Reduction in agricultural land , TOD zones

Transformations due to TOD

- **Transit-Oriented Development:**
  - BRTS-focused Development: Successful corridor densification
  - Mixed-use promotion along BRTS
  - Integration with heritage areas
- **BRTS Impact:**
  - 25-35% increase in commercial activities
  - Mixed-use development along corridors
  - Improved accessibility to industrial areas

Land Use	Change	Metro Station
Residential	High-density development	Naranpura, Naranpura, Thaltej, Vastral
Commercial	Mixed-Use developments	Ashram Road, Kalupur, CG Road

Figure 54- Land use changes

- **Ashram Road Corridor (BRTS + Metro)**
  - Mixed-use commercial and high-end towers have arisen after TOD policy.
  - Walkability enhanced by redesigned footpaths, vending areas, and parks.
  - Public realm upgradation facilitated land value appreciation and private investments.
- Vastral and Kalupur Nodes
  - Vastral TOD area includes metro station with group housing nearby.
  - Kalupur Metro station land is overlapping railway terminal, to be constructed as multimodal hub.

Land Values

- **Metro Corridors:** Property values rise.
- **BRTS Corridors:** Higher appreciation than metro, in central commercial areas.
- 200m Radius (BRT): 20% premium for properties.
- 30-40% along the BRT, versus 20-25% citywide.

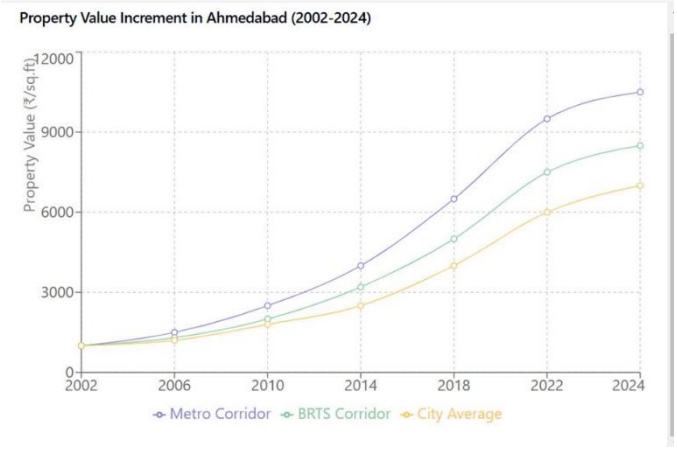


Figure 55-Ahmedabad land value chart

- Central areas have the highest property value increments.
- Improved connectivity allows for a jump to peripheral areas.
- Increased impact on commercial properties.

Key Learnings from Ahmedabad's TOD Model

- **Statutory Planning Integration:** Inclusion of TOD in Development Plan and Town Planning Schemes makes it enforceable by law.
- **Node + Corridor Approach:** Station precincts and longitudinal corridors' consideration allow area-scale change.
- **Institutional Continuity Issues:** Coordination of AMC, AUDA, and CEPT at periodic intervals guaranteed long-term implementation.
- **Mixed Outcomes Without Infrastructure Alignment:** Periphery TOD locations need infrastructure upgrades and land readjustment to succeed.
- **Public Realm Design is Critical:** Walkability, shade, vending, and security directly impact the success of TOD.

Key Takeaway:

- LAPs and corridor-level planning represent an existing approach to phased TOD implementation. Institutional stability and land readiness are a necessity.

3.3 Key Learnings from Case Studies

City	Key Strengths	Challenges	Relevance to TOD Strategy
Singapore	Integrated land-transit planning; LVC model	High cost of replication in other cities	TOD funding & implementation
Copenhagen	Regional corridor-based planning; strong urban form	Needs long-term vision and governance stability	Corridor-wide TAC planning
Cape Town	Inclusive TOD framework; equity-focused	Execution slow; funding bottlenecks	Addressing spatial exclusion and affordability
Delhi	Policy-driven TOD zones and overlays	Land pooling, litigation, weak execution framework	Institutional TOD overlays and zoning tools
Bengaluru	Real estate growth near stations	Weak planning, poor integration	Last-mile and zoning regulation need
Ahmedabad	Integration of metro and BRT; strong LAP model	Uneven execution in outer zones	Staged TOD rollout using LAPs and corridor typology

Table 15- Case Studies Comparisions

4 STUDY AREA

4.1 STUDY AREA INTRODUCTION

Nagpur, geographically situated at the heart of India, is one of the fastest-growing tier-2 cities and is a regional node for Maharashtra and central India. The city has witnessed high spatial and economic growth during the last two decades, driven by industrialization, infrastructure growth, and its position as a key educational and institutional hub. The city's population, currently in excess of 2.4 million (urban agglomeration), will grow significantly and exert pressure on mobility networks, housing, and infrastructure.

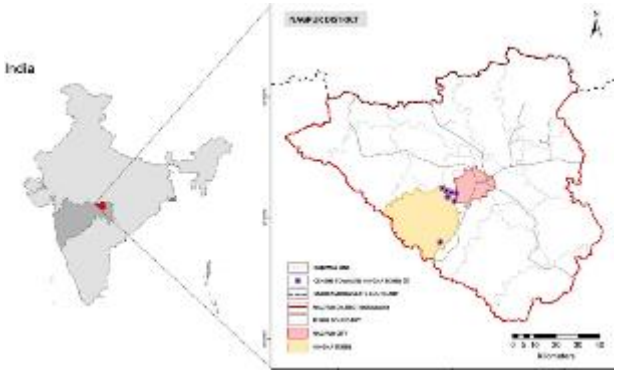


Figure 56-Nagppur Map

Figure 57- Hingna Map

Urban growth in Nagpur is now more towards the peripheries, especially in locations like Hingna Taluka — a new growth corridor along the city's western periphery. The city's traditional radial growth has now been shifting into corridor-based growth, with significant impact from the development of high-capacity transit systems like the Nagpur Metro.

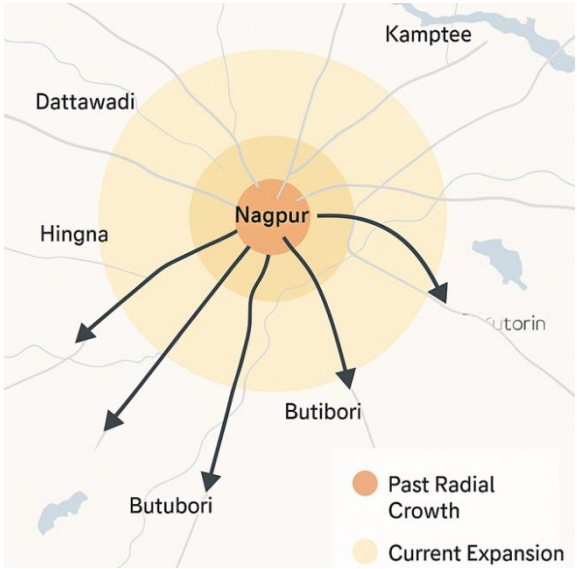


Figure 59-Nagpur Peripheral Growth

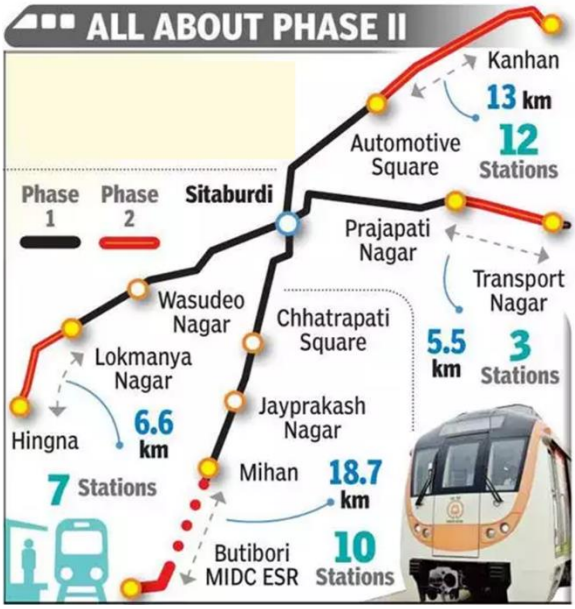


Figure 58-Nagpur Phase 2 extension

Nagpur Metro has been developed in two phases. Phase 1, which is partially operational, aims to connect north-south and east-west corridors, providing significant connectivity between the city's core areas. Phase 2, which is being executed, provides metro connectivity to growth centers in the region, with new corridors like Lokmanya Nagar to Hingna (Corridor-3A). This planned extension is of the greatest importance as it forms a direct connection between the peripheral settlements of Hingna Taluka — institutional, residential, and industrial estates — with the rest of the city.

Hingna itself has developed from an industrial side product of MIDC to a mixed-development urban cluster, including big educational campuses (such as YCCE, Priyadarshini), planned group housing schemes, and illegal expansion. Though it has developed, the site has numerous issues — varied land use, disorganized growth, and absence of organized infrastructure and public transit connectivity.

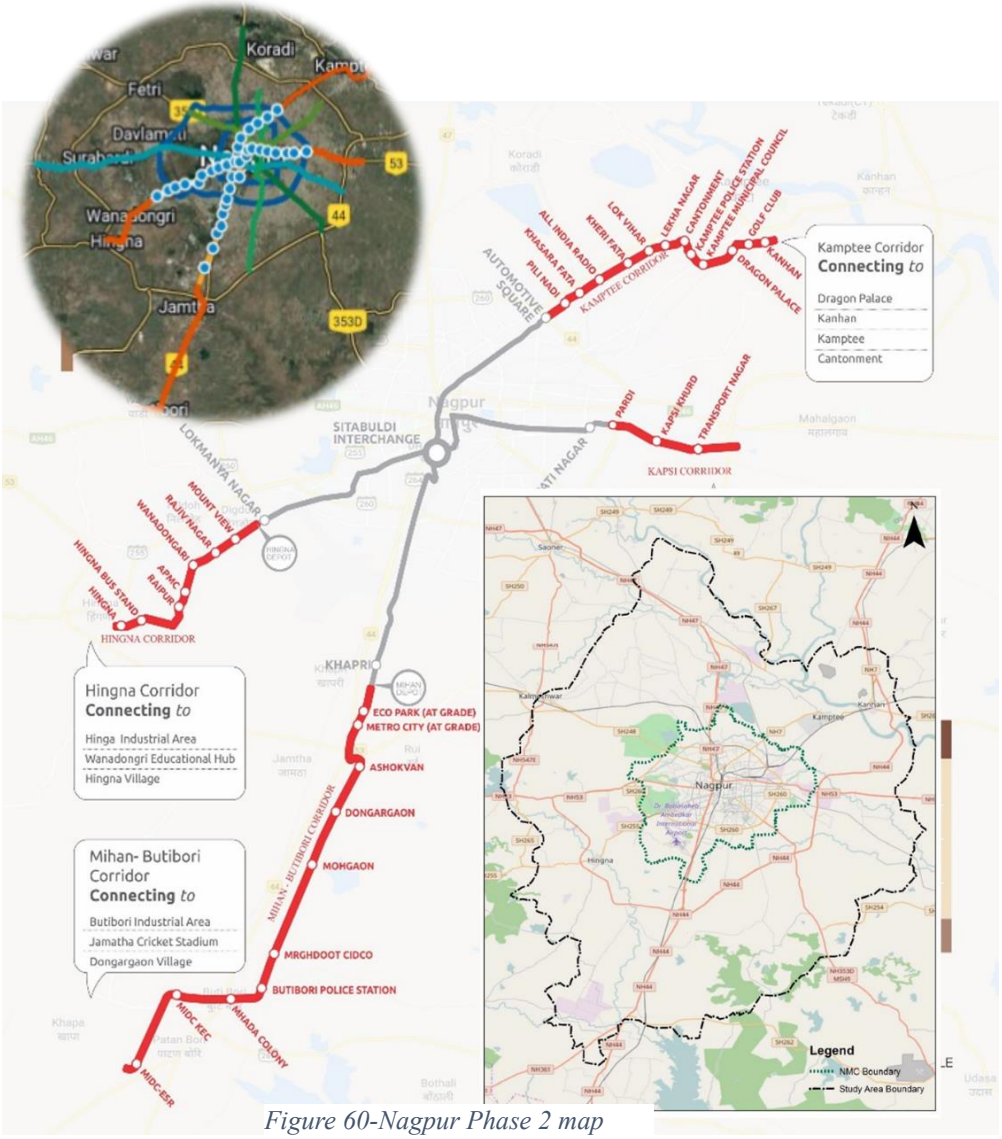


Figure 60-Nagpur Phase 2 map

The Lokmanya Nagar-Hingna corridor of Metro Phase 2 is about 6.657 km long and has seven stations. The corridor passes through a heterogenous urban fabric: low-density residential, large educational campus complexes, wholesale markets (APMC), and industrial peripheries. The existing land-use pattern is mostly residential and public/semi-public in nature with small commercial and industrial pockets scattered here and there. Vacant parcels and non-developed tracts hold enormous potential for infill development as well as formal expansion.

4.2 Lokmanya Nagar to Hingna corridor

- Runs along west edge of Nagpur city, within Hingna Taluka,
- Connects central urban & rapidly expanding suburban and industrial districts.
- Corridor is 6.657 km long & comprises Seven Elevated Metro Stations:

4.2.1 Planned metro stations:

- Hingna Mountview
- Rajiv Nagar
- Wanadongri
- APMC
- Raipur
- Hingna Bus Stand
- Hingna Terminal

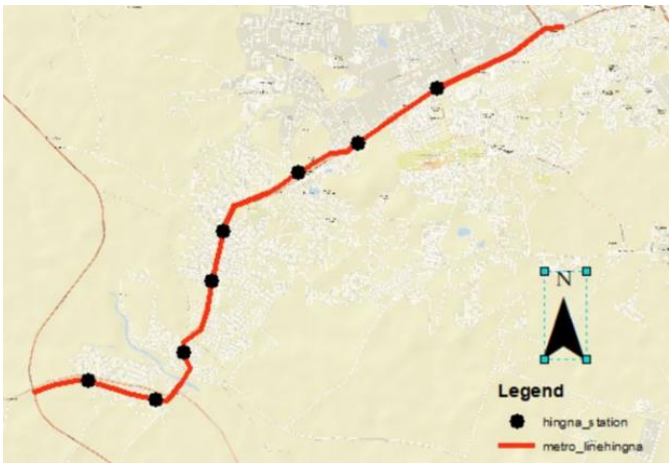


Figure 61-Metro Station

4.2.2 Station Details (with Chainages)

Station No.	Name	Chainage (m)	Distance from Previous (m)
1	Hingna Mountview	18761	-
2	Rajiv Nagar	19607	846
3	Wanadongri	21006	1399
4	APMC	21715	709
5	Raipur	22823	1108
6	Hingna Bus Station	23625	802
7	Hingna Terminal	24504	879

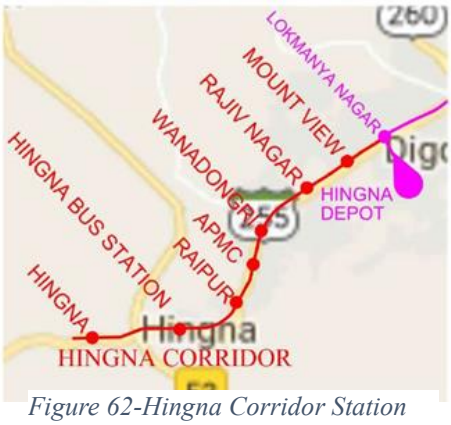


Figure 62-Hingna Corridor Station

4.2.3 Corridor Characteristics & Land Use Dynamics

The corridor cuts through residental tracts alternating with educational, institutional (PSP), wholesale commercial (APMC), and industrial complexes. The place is a viable spot for TOD-based development on the strength of bulk empty plots, institutional centers, and property value appreciation in the wake of Metro.

This corridor is chosen for detailed analysis because it

- Uninterrupted urban growth along the corridor towards Hingna–MIDC
- Scale of institutional concentration of land (YCCE, RTMNU, engineering campuses)
- Residential demand augmentation because of new plotted and group housing schemes
- Multiplication of MIDC-held plots and scattered uncontrolled development
- Presence of capturing Transit-Oriented Development (TOD) transformation

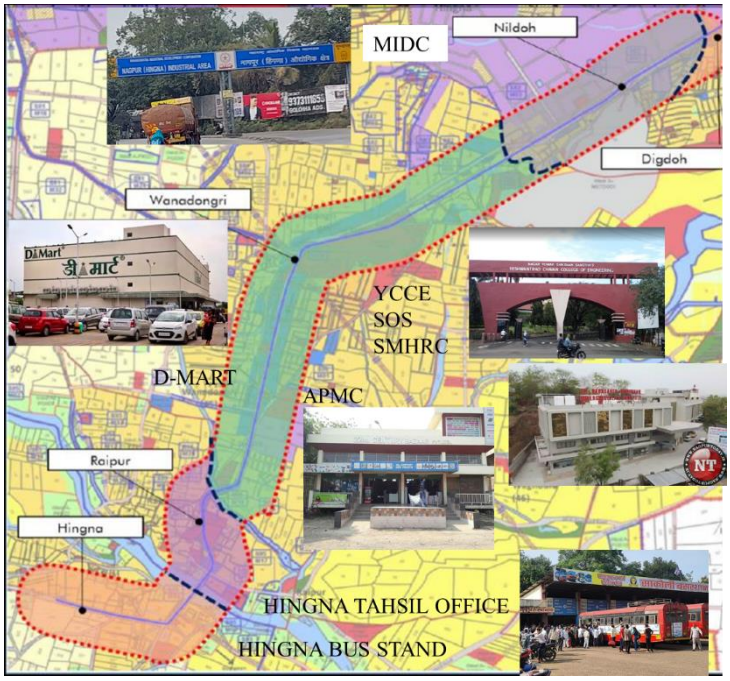


Figure 63- Corridor Surrounding Characteristics

The significance of this corridor is that it has the potential to act as a driver for imparting sustainable urban growth in west Nagpur. With metro connectivity, travel distances between Hingna and city center locations will be much shorter. This increased accessibility will be an impetus to economic growth, induce real estate investment, and facilitate land conversion at strategic locations.

Strategic Transit-Oriented Development (TOD) on the corridor will plug the existing voids in city form, enhance mobility and access, and organize future growth into a more compact, connected, and sustainable fashion. The corridor can be developed as an exemplary model for bringing transit, land use, and public realm upgrade together to shape it as an efficient, economical, and habitable urban backbone to induce private sector investment.

Corridor Stretch	Key Urban Features
Eastern Stretch (Lokmanya Nagar to Wanadongri)	Low-rise residential to Medium-density plotted housing, informal layouts, group housing clusters & societies Institutional nodes: YCCE, Priyadarshini,
Central Stretch (APMC and Raipur)	Dominated by wholesale, unorganized markets & commercial expansion Partly organized residential enclaves, weak civic infrastructure
Western Stretch (Hingna Bus Station to Terminal)	State and private bus hubs (regional transport node) Vacant/open lands, encroachments, unauthorized dwellings

Table 16-Corridor Characteristics

4.3 Population Study

- Corridor Stretch: Lokmanya Nagar to Hingna (Nagpur Metro Phase 2)
- Influence Zone: 1 km buffer on either side of the metro corridor
- Administrative Geographical Areas Covered:
  - Villages: Digdoh, Hingna, Nildoh, Raipur, Wagdara, Wanadongri
  - Wards: In peri-urban and NMC (Nagpur Municipal Corporation)

4.3.1 Population Growth

Village	Area (ha)	2011 Population	2024 Population	2041 Population
Wanadongri	251	32,000	49,000	72,000
Digdoh	352	24,000	31,000	46,000
Nildoh	251	14,500	18,000	29,000
Hingna	695	8,800	10,500	15,000
Raipur	181	10,500	13,000	18,000
Wagdara	200	7,600	9,200	12,000

Table 17-Population Growth

4.3.2 Population Density

Village	Area (ha)	2011 Density	2024 Density	2041 Density
Wanadongri	251	127.49	195.22	286.85
Digdoh	352	68.18	88.07	130.68
Nildoh	251	57.77	71.71	115.54
Hingna	695	12.66	15.11	21.58
Raipur	181	58.01	71.82	99.45
Wagdara	200	38.00	46.00	60.00

Table 18-Population Density

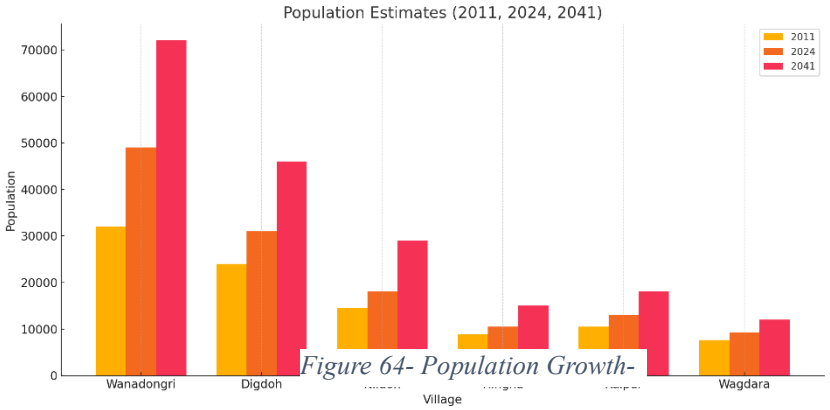


Figure 64- Population Growth-

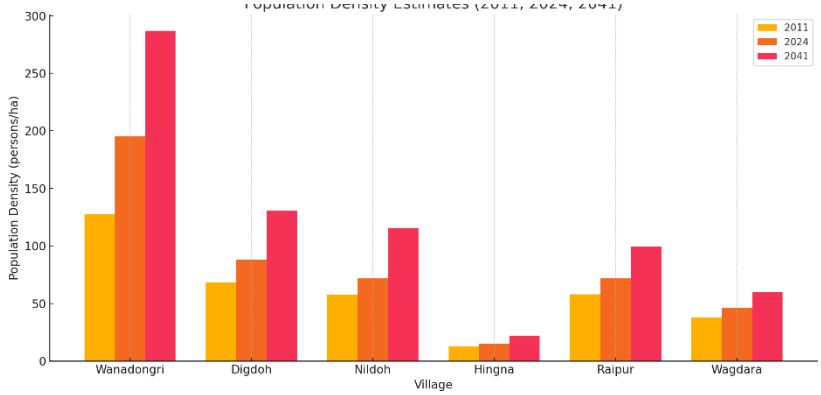


Figure 65-Population Density

Observations:

- Wanadongri has the largest population gowth at all years,
- Digdoh and Nildoh exhibit high growth, reflecting their rising residential significance.
- Hingna continues to be the lowest density area (just ~22 persons/ha in 2041), reflecting enormous underdeveloped land though it is an origin node.

All village densities reflect increasing trend, with Wanadongri to cross 286 persons/ha in 2041, reflecting transition to an urban compact zone.

Raipur and Wagdara exhibit incremental but consistent increases, an indication of pressure from surrounding development.

Hingna and Digdoh exhibit comparatively lesser densities owing to space occupied by industrial and institutional uses.

Conclusions

- Increasing densification, especially in Wanadongri, necessitates intensive TOD planning, upgradation of utilities, and provision of open spaces in order to avoid urban stress.
- High density + growth villages such as Wanadongri and Nildoh are the most promising candidates for TOD overlay zones and vertical development incentives.
- Such locations as Hingna (MIDC) and Digdoh are dominated by non-residential character, falling population density but rising employment-led influx.
- Population growth along the corridor is directly proportional to anticipated increase in ridership and reliance on metro and feeder networks.

- By 2041, the corridor population would exceed 200,000+, and it would require a multi-nodal development strategy with density balance, land use zoning, and integration of mobility.

4.3.3 Ridership Data

- **Network Extension:** Phase 2 extension serves the under-served segments such as Hingna and MIDC, gaining new riders.
- **Enhanced Interchange:** Enhancing inter-station interchange between Phase 1 and Phase 2 enhances smooth travel, adding overall trip volume.

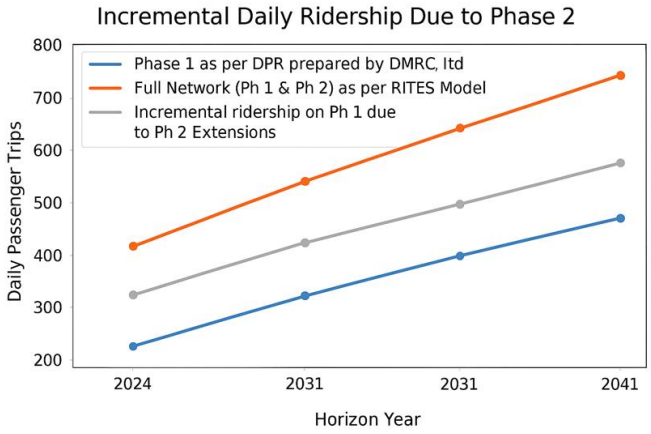


Figure 66-Incremental Daily Ridership

- **Urbanization:** High residential and institutional development along the Hingna corridor creates higher transit demand.
- **First/Last-Mile Integration:** Planned multimodal stops and feeder services promote the usage of public transport.
- **Increased Access to Workplaces**: Facilitation of access to MIDC, educational areas, and market points makes metro the most sought-after mode for daily travel.

TABLE 0.3: DAILY RIDERSHIP IN NAGPUR PHASE 1 & 2 METRO CORRIDORS

S. No.	Corridor	Daily Ridership (Lakh)		
		2024	2031	2041
1	Kanhan River - Automotive Square – MIHAN - MIDC ESR	2.61	3.00	3.73
2	Transport Nagar - Prajapati Nagar - Lokmanya Nagar – Hingna	2.58	2.98	3.62
3	Vasudev Nagar – Dattawadi	0.30	0.35	0.39
	Total Trips	**5.49**	**6.33**	**7.75**
	Daily Total Interchange Trips	1.31	1.54	1.83
	Total Boarding	**6.80**	**7.87**	**9.58**

Table 19 Daily Ridership Data

Observation

- The ridership is expected to increase incrementally between 2024 and 2041, particularly on corridors such as Lokmanya Nagar–Hingna, which alone contributes to more than 3.6 lakh trips/day by 2041.
- Phase 2 complements Phase 1 usage, reflecting a high network synergy and passenger preference for through-routing.

Inference

- Ridership peak is guaranteed to demand TOD planning and transit-supportive development in proximity to core stations.
- Phase 2 corridors also determine dense, high-density, and integrated urbanization zones.

4.4 Built Environment and Urban Form

4.4.1 Housing & Settlement Type:

Zone	Housing Type	Density Category
Wanadongri	Group housing, PGs, plotted	Medium to High
Nildoh	Plotted housing, G+2/3	Medium
Digdoh	Mixed informal + apartments	Medium
Hingna	Rural housing, few apartments	Low
APMC Node	Slums, rental, roadside units	High (unplanned)
Isasani Area	New residential townships	High rise potential

Table 20-Housing & Settlement Type

- Low-rise (G+1 to G+3) plotted development in large areas
- Setbacks and Edge Conditions: Varies in residential layouts and High boundary walls around institutional blocks
- Poor active frontage along Hingna Road
- Public Space Deficit: No planned plazas, covered pedestrian walkways, or usable open space within and around most of the stations

4.4.2 Infrastructure & Utilities

- Water Supply & Sewerage: Available in Rajiv Nagar, Wanadongri; missing or informal in CRPF and periphery Hingna layouts
- Storm water: Drains open, partially blocked or choked during monsoon (visible along with APMC).
- Lighting & Electricity: Operational streetlights on Hingna Roa ; broken in slums
- Solid Waste: Poor collection, particularly in periphery peri-urban and informal (Raipur, CRPF)

- Network Connectivity: Good network connectivity near institutional and commercial areas. TOD Potential and Readiness.

4.5 Challenges

Lokmanya Nagar–Hingna corridor is influenced by unplanned development, scattered land use, and environmental pressure owing to uncontrolled development. There is no defined hierarchy of land use and road networks are balkanized, restricting connectivity. Pedestrian infrastructure is inadequate, and metro/public transport connectivity is poor, particularly in outlying areas such as Hingna and Isasani.

Station areas in general are plagued by small plots, thin streets, and unorganized development, which inhibits high-density TOD potential.

There must be TOD redevelopment that introduces smart land use planning, enhanced multimodal connectivity, walkability, and compact, transit-oriented development along the corridor.

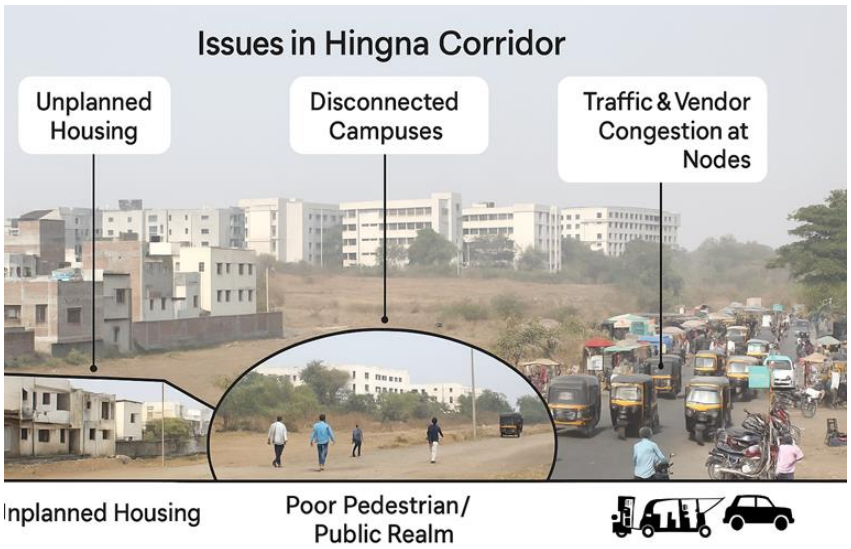
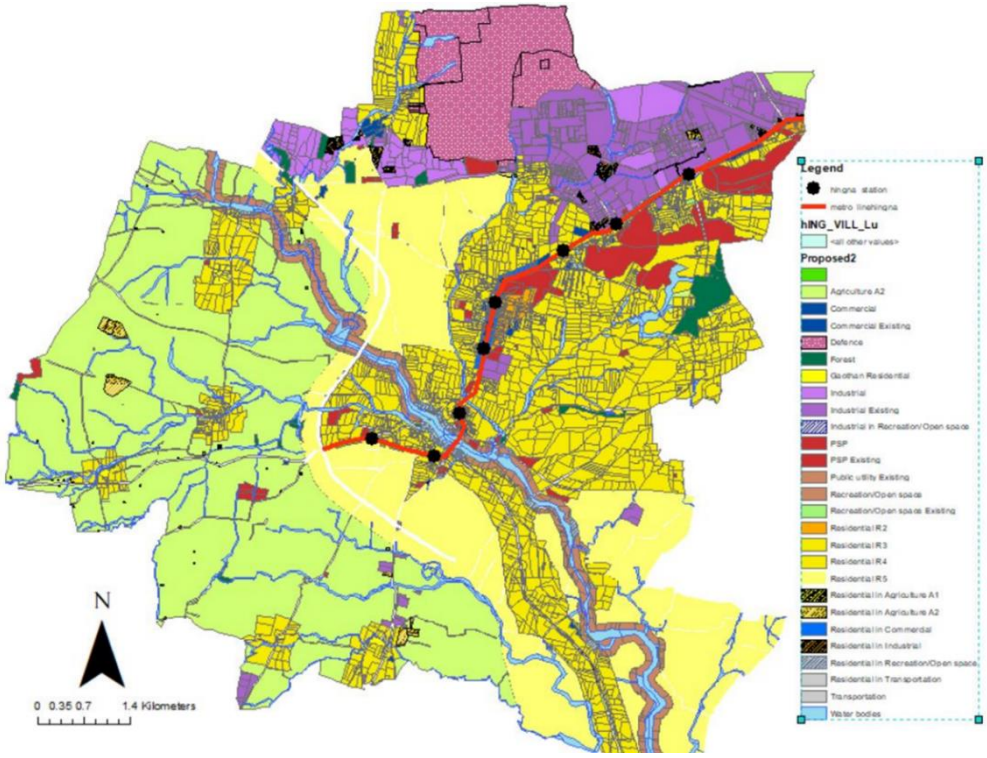


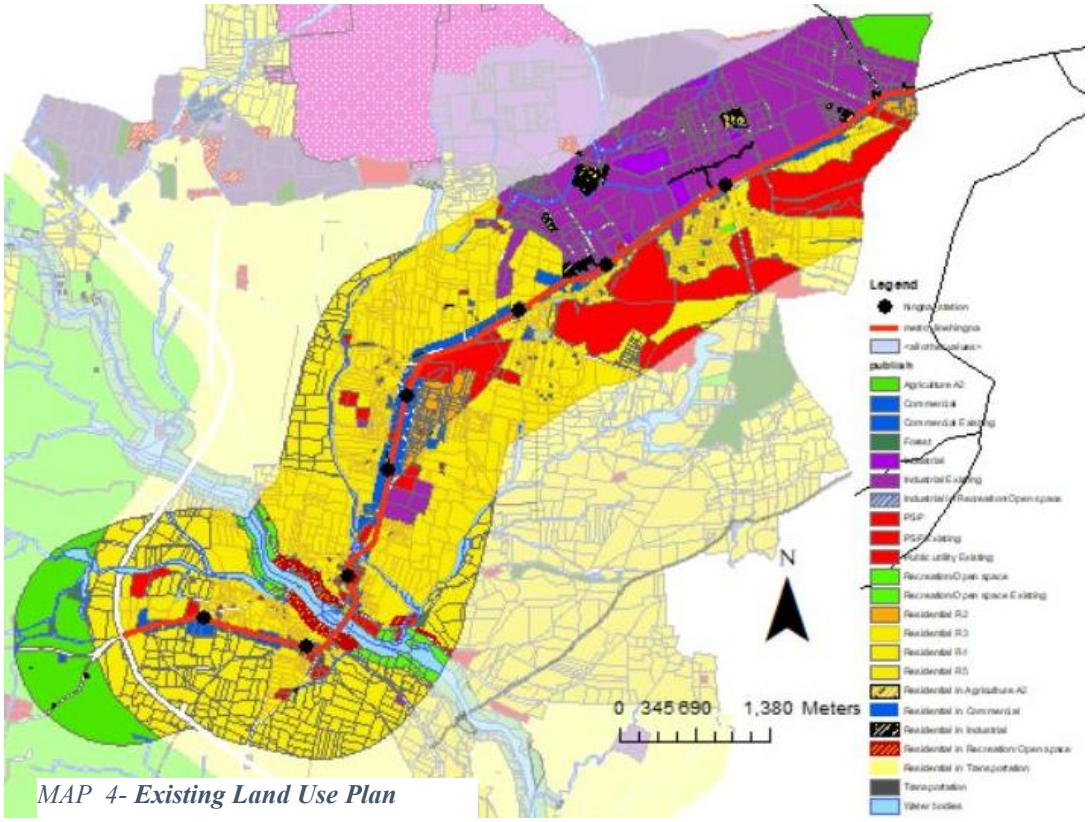
Figure 67-Challenges in Corridor

4.6 Land Use Pattern and Urban Typology

The corridor passes through various urban typologies from consolidated residential areas to emerging residential areas, institutional campuses, and industrial sites:



MAP 3-Proposed land use as per DP



*MAP 4- **Existing Land Use Plan***

Land Use Category	Existing %	Proposed %
Residential	61.9%	64.3%
Commercial (Blue)	3.7%	2.1%
Public/Semi-Public (Red)	25–30%	4.7%
Industrial	5–7%	9.4%
Open Space/Recreation	3–4%	5.8%
Water Bodies	2–3%	7.1%
Agriculture/Vacant	2–4%	0.55%

Figure 69-land use

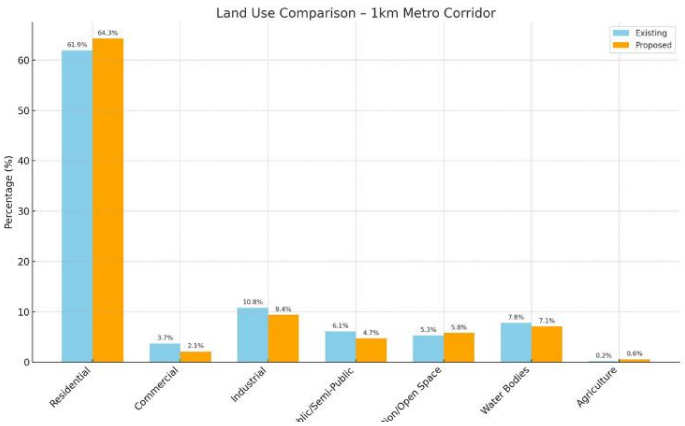


Figure 68-Land use comparison Chart

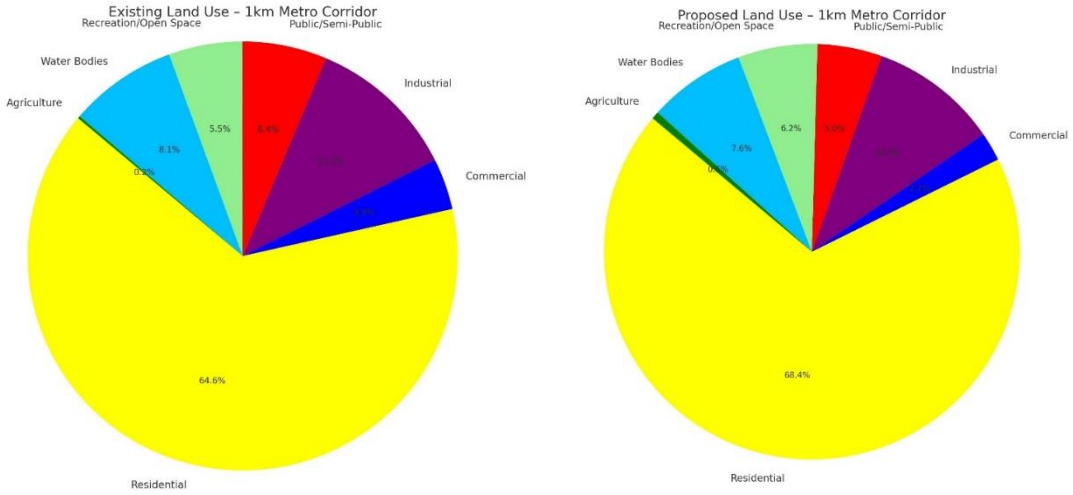
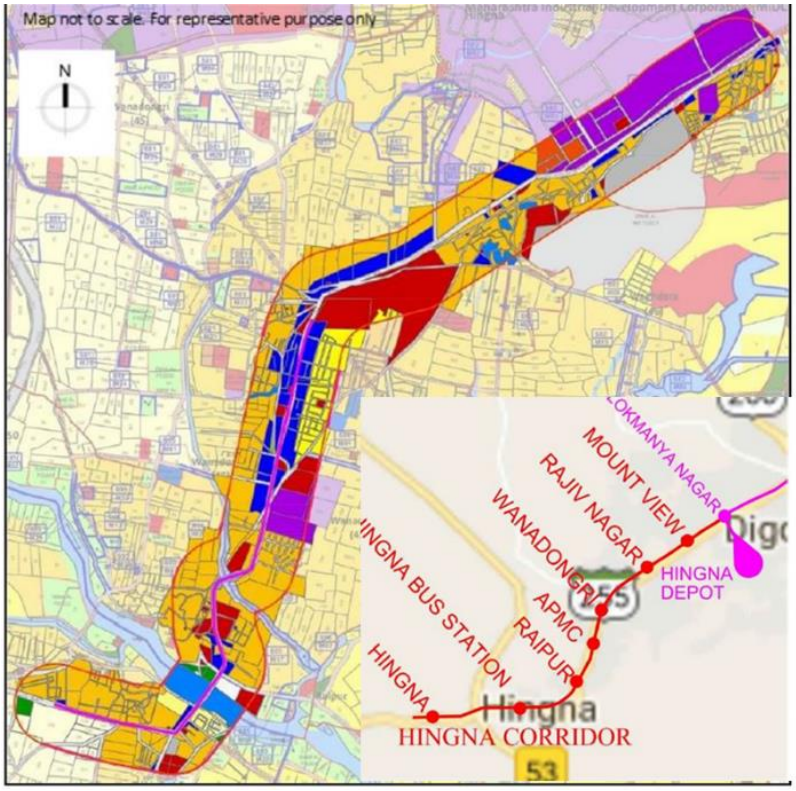


Figure 70- Existing & proposed land use pie chart

Key Observations:

- Residential landuse was converted as mixed use.
- Increase in commercial development. Commercial nodes are defined and limited — APMC and Hingna are most densely populated in nature.
- Increase in Institutional development of wanadongri region.
- Open space is limited and fragmented — space for green buffers and public space creation as related to TOD.
- The PSP land base is extremely expansive due to homongous institutional campuses (YCCE, Priyadarshini, SVSSCER).
- Residential is the common usage in irregular forms — plotted developments, G+2 houses, and new group housing.

4.7 TOD Zone Land Use (Accurate 500 km TOD Zone)



MAP 5-TOD Zone Land Use (Accurate 500 km TOD Zone)

Land Use Category	Percentage (%)
Residential	55%
PSP (Public/Semi-Public)	30%
Commercial	8%
Industrial	3%
Open/Recreation	4%

Table 21-TOD Zone Land Use table

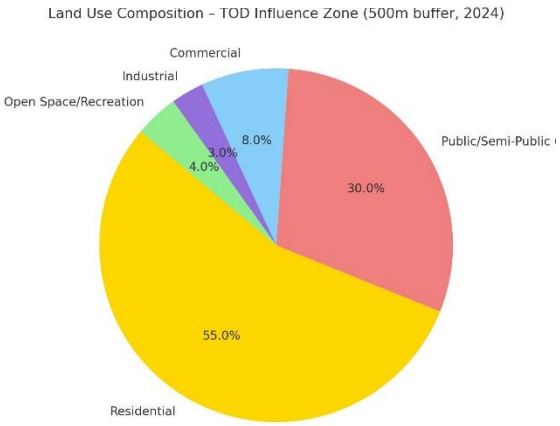
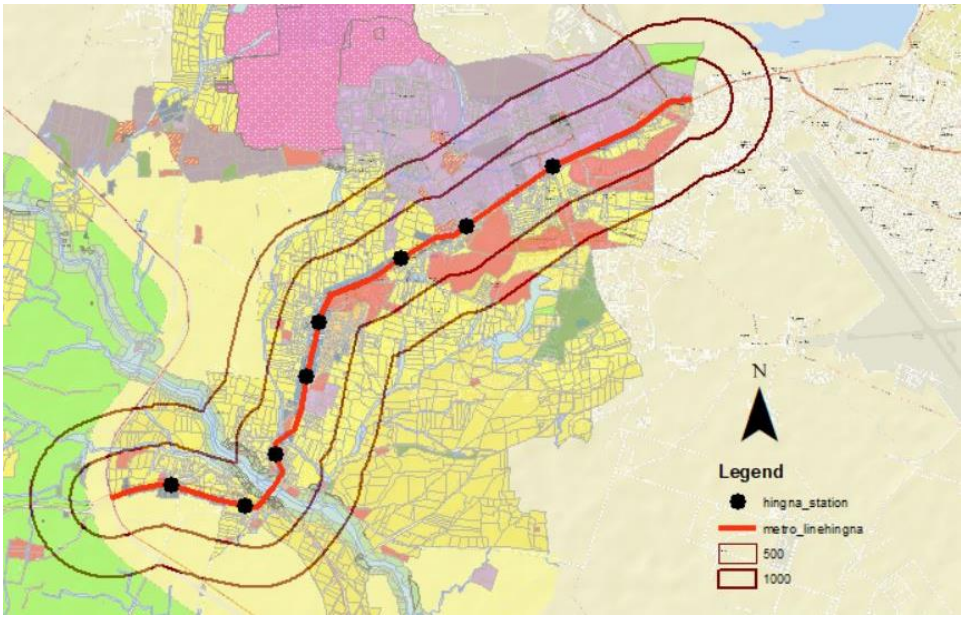


Figure 71-TOD Zone Land Use Pie chart

4.7.1 Land Use Dominance Patterns:

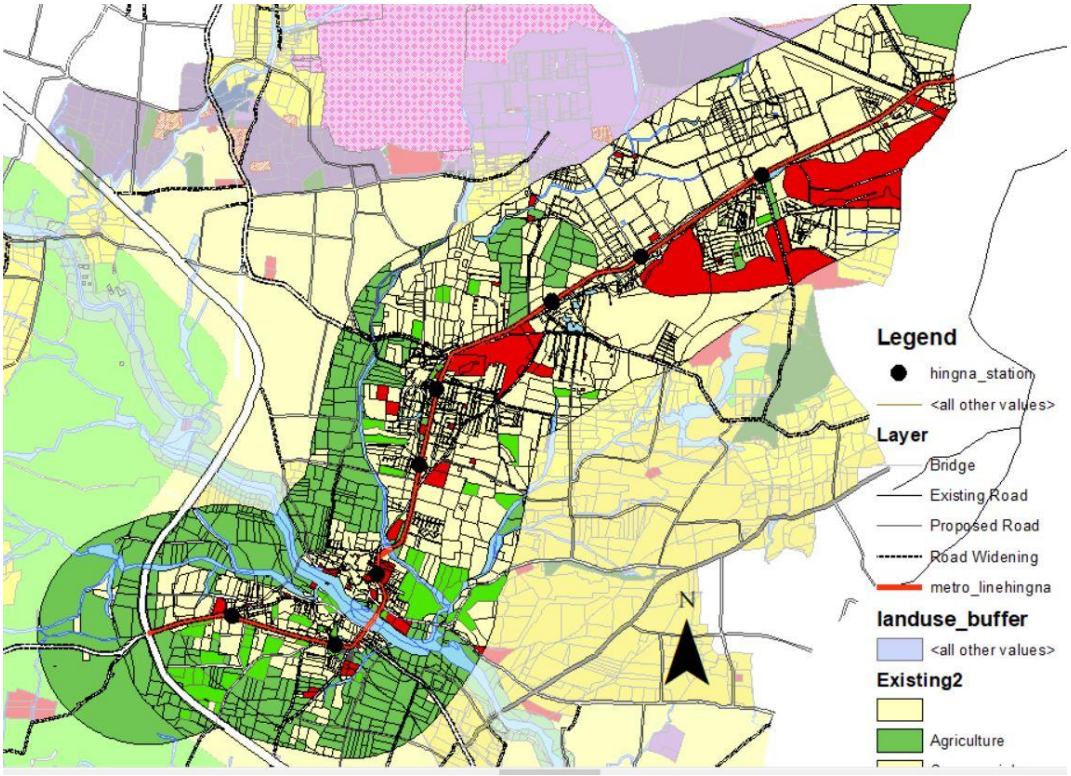
- Residential and public semi-public land use are prevalent in this zone. Scattered along the corridor, particularly around Wanadongri, Rajiv Nagar, and Raipur,
- Mixed use development is on the rise, the corridor also provides the opportunities for TOD development, mixed use development, high rise development as a result of FSI increase due to metro.
- Commercial development along main road mostly around: APMC (central segment), Hingna Bus Stand (terminal node), Lokmanya Nagar and portions of Wanadongri
- But because of absence of proper regularization and planning it had resulted in unplanned development.

- Public/Semi-Public (Blue): Wanadongri holds large PSP land blocks due presence of industries and institution (YCCE and Priyadarshini campuses), whereas PSP clusters are observed above Rajiv Nagar.
- Industries: Found on the eastern periphery (MIDC areas) and the north boundary, particularly after Lokmanya.
- Dispersed Green pockets and lack of proper Open Spaces or Recreational Space
- Water Bodies and Drainage Zones -Observed predominantly over the southern boundary of the corridor.



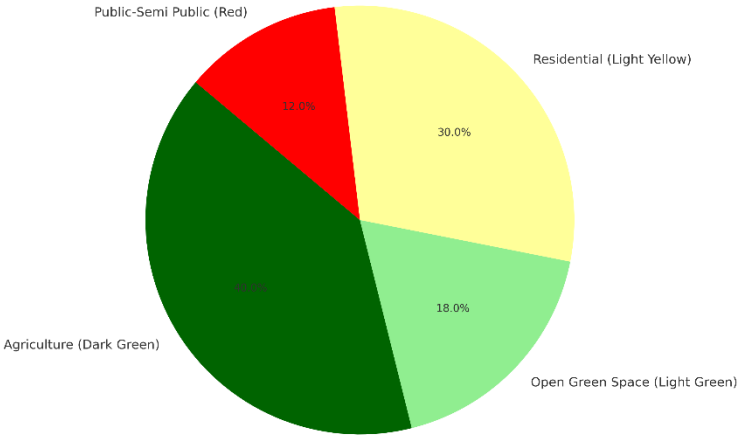
MAP 6-Buffer Map of corridor

4.7.2 Vacant Land



Key Observations

- Agricultural land continues to hold the biggest 40% share, a reflection of dominant rural nature.
- Residential follows at 30%, urbanizing with approximated nascent metro hubs.
- Open green space holds 18%, to be developed for environment buffers and public areas.



- Public–Semi Public (PSP) use holds 12%, as a reflection of government and institutional land ownership. (Schools, hospitals, etc.).

Inferences

- High agricultural percentage tells of possible redevelopment for housing TOD and mixed-use infill.
- PSP land can offer space for densification opportunities for anchor institutions and civic infrastructure.
- An equal balance of residential and public land can allow for a livable city form if planned at the urban scale.
- Green space must be preserved along with urban development to maintain livability and resilience.

4.8 Station Node Analysis

4.8.1 Wanadongri Station – Institutional TOD Node

Existing Context:

Wanadongri is in the center of western Nagpur's education zone. Major institutions such as YCCE, Priyadarshini Engineering College, and SVSSCER own the node. Campuses experience high daily interaction and floating students and faculty population.

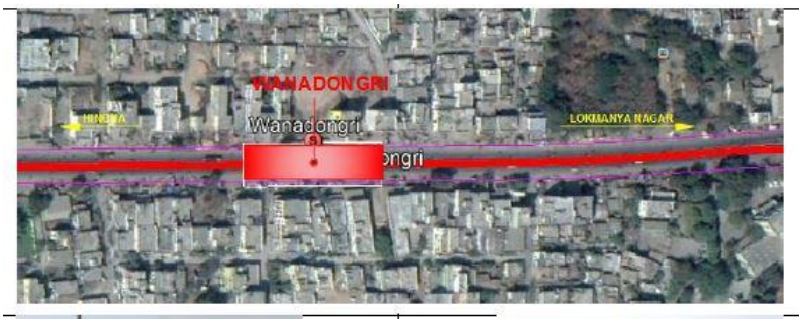


Figure 72-Wanadongri Station -

Land Use & Built Form:

- Characterized by Public/Semi-Public (PSP) land (~30% within 800m)
- Residential form around campus (plotted & group housing)
- Vacant institutional land and hostels
- Limited commercial plots — primarily informal kiosks, food stalls, PGs

Infrastructure Conditions:

- Internal roads exist but without sidewalks and signage
- Informed parking and car saturation subvert pedestrian safety
- Public realm severed; campuses turn inward

TOD Potential

Typology: Institutional TOD. Mixed-use zoning: retail + student housing + services

FSI incentives for integrated educational-commercial developments

4.8.2 APMC Station – Market/Commercial TOD Node

Existing Context:

A highly crowded and congested node in the corridor. APMC parcel is half-wholesale center and retail trade. It receives high volumes of goods traffic, IPT vehicle traffic, vendors, and pedestrians during daytime.

Figure 73-APMC Station

Land Use & Built Form:

- High commercial density of use (10–12% of TOD zone), with separate PSP and residential zones
- Narrow divisions of plot, random parking, no unloading/loading facilities
- Open public spaces entirely dominated by vendor or informal occupation

Mobility & Infrastructure Gaps:

- Pedestrian movement vs. logistics conflict
- No pedestrian crossings, waiting bays, or cycling entry
- Disorganized on-street parking and vendor pushcarts

TOD Potential

- Typology: Market-Based TOD
- Re-develop with organized parking + vendor arcade space
- Pedestrian-only zones during peak hours
- Improve commercial blocks with vertical zoning (Retail + Office)

4.8.3 Hingna Bus Stand – Intermodal TOD Node

Current Situation:

Terminus corridor, Hingna Bus Stand is the primary interface of the metro, state buses, autos, and para-transit modes. Also connected with the MIDC industrial park and peripheral rural markets.

Figure 74-Hingna Bus Stand

Land Use & Urban Texture:

- Industrial (MIDC), residential, empty, and commercial land mix
- Informal bus operation; uneven platforms and poorly defined pedestrian space
- Government land holdings and MIDC plots in the area

Transit Challenges:

- No organized interchange with metro and others
- No walkway for pedestrians, seating, shelters, or walkways with shade
- Pedestrian traffic crash with motor vehicle traffic
- Spaces can be designed as feeder loops or plazas

TOD Potential & Proposals:

- Type: Intermodal TOD
- Design a transit plaza with metro + buses + autos in one node
- Insert retail storefronts on transit streets (transit-oriented retail)
- TOD overlay with mixed-use real estate incentives.

4.8.4 TOD Node Comparison Summary

Node	Typology	TOD Features Needed	Potential Uses
Wanadongri	Institutional	Campus edge design, student housing, NMT	Education, Housing, Mixed-use Retail
APMC	Commercial	Vendor reorganization, pedestrian zones	Retail, Markets, Logistics
Hingna Bus Stand	Intermodal	Transit plaza, shared transport integration	Mixed-use, Parking, Feeder Hub

Table 22-TOD Node Comparison Summary

4.8.5 Station wise Analysis

Station	Land Use	Housing Typology	Building Typology (Floors)	Typical Plot Size (sq.m.)	Road Width (m)	Catchment Area	TOD Potential
Hingna Mount View	Residential, Mixed-use	Plotted, group housing	G, G+1, some G+2	150–300	12–18	Mount View, LIC Colony, SRPF	High
Rajiv Nagar	Mixed-use	Independent houses	G, G+1, few G+2	200–400	15–18	Rajiv Nagar, Nara, Shatabdi Nagar	Moderate
Wanadongri	Residential + Institutional	Plotted, group housing	G+1 to G+3	250–500	15–18	Wanadongri, Metropark Layout, Mahindra Hills	High
APMC	Commercial (Market)	Marginal housing, commercial	G, G+1 (godowns, shops)	300–1000+	18+ (main), 9–12 (internal)	APMC Market, Mahajanwadi	High
Raipur	Residential	Independent houses	G, G+1	150–300	9–12	Raipur village, Hingna Road	Moderate
Hingna Bus Station	Commercial / Transit Hub, Mixed-use, and agricultural land	Limited resi., group housing emerging. more vacant land	G+1 (old), G+3–G+5 (new projects)	200–600	18–24	Bus Station area, nearby commercial clusters	High
Hingna	Mixed-use and agricultural land	Low-rise, group, and worker housing types, more vacant land	G to G+5	200–800	18–24		High

Table 23-Station wise Analysis

Key Observations:

Because of internal road width and small plot size in this corridor is less than 6-12 m because of this building height and development restricted.

Irregularized scheme and illegal development on plots have resulted in unsuitable development and overcrowding and unproductive land development

4.9 Connectivity & Infrastructure Conditions

The Lokmanya Nagar–Hingna corridor sees some multimodal connectivity lacunas and last-mile infrastructure. There are no unorganized bus–metro interchange points, and unauthorized IPT (auto-rickshaw) operations within station areas cause congestion and unsafe journeys. There is no public bike-sharing facility and cycle parking and hence unsustainable last-mile options are avoided.

Roadside Encroachment and Cyclists in Wrong Side

Figure 75-Infrastructure Conditions

Pedestrian and cyclist signage and wayfinding are poor, and pedestrian routes do not exist, have been taken over by street vendors, or are unsafe, particularly along Hingna Road (SH-265) and around overcrowded station zones. Overall Non-Motorized Transport (NMT) infrastructure continues to be poor, restricting access and pedestrian convenience.While there has been a 25–30% increase in mid-rise (G+5) group housing across neighborhoods such as Wanadongri and Hingna, the corridor is short of systematic last-mile connectivity to handle this increased residential density..

Station	Footpaths Availability	Pedestrian Coverage	Safe Crossings	Cycle Infra	Public Realm Condition
Wanadongri	Moderate footpaths Only along Hingna main road (discontinuous inside residential lanes)	~30–40% footpath coverage within 500m	Poor (no zebra crossings visible)	None present	Minimal; no shaded walkways, no plaza space
APMC	Severely blocked footpaths by vendors	~10–15% footpath coverage (very poor)	Non-existent; no formal crossings.	None	Very poor; congestion and informal vending dominate
Hingna Bus Stand	Open, wide roads, Moderate; some sidewalks visible but fragmented	~50% with gaps at crossings	Few informal crossings, no signals	None	Potential for plaza development but currently no organized public realm

Figure 76-Connectivity & Infrastructure

Conclusion: These factors point strongly towards the necessity of TOD overlays, pedestrian realm improvement, feeder systems, and multimodal node planning. Wanadongri and Hingna station precincts have tremendous potential for urban redevelopment through TOD if these issues of mobility are resolved.

4.10.1 TOD Readiness Assessment (Station-wise)

- The TOD Readiness Assessment was made on the following key indicators:
- Land Use Mix: Residential, commercial, institutional activity diversity and intensity.
- Density Patterns: Density and population density in 500m buffer area around stations.
- Walkability: Pedestrian path condition, crossings, block size.
- Multimodal Integration: Smooth access to metro, bus, IPT modes.

The scoring process combined these indicators to decide station ranking on TOD potential.

Station	TOD Readiness (out of 10)	Walkability (out of 10)	Multimodal Integration
Wanadongri	7	6	5
APMC	4	2	3
Hingna Bus Stand	8	6	8

Table 24-Station-Wise TOD Typology Table

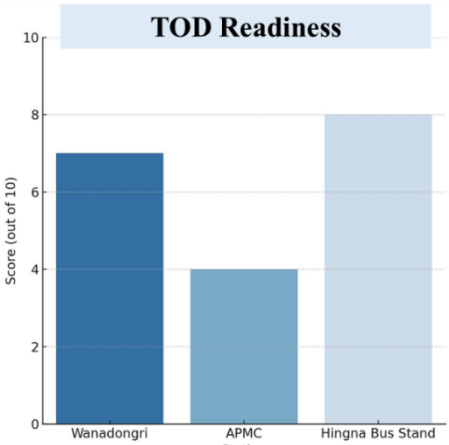


Figure 77-TOD Readiness

- High Potential Zone → Hingna Bus Stand
- Moderate Potential Zone → Wanadongri
- Low Potential Zone → APMC

4.10.2 Walkability & Accessibility Analysis

Criteria	Wanadongri	APMC	Hingna Bus Stand
Footpath Availability	Poor	Very poor	Moderate
Shaded Walkways	No	No	No
Safe Crossings	Rare	Absent	Minimal
Cycle Infrastructure	Absent	Absent	Absent
Last Mile Feeder (Bus/E-Bike)	None	None	Feasible if created

Table 25-Walkability & Accessibility Analysis

- Poor footpaths on Hingna Road. Lacking safe pedestrian crossings close to station entry and exit points. No cycle tracks even close to educational hubs like Wanadongri.
- Poor last-mile connectivity with no IPT is close to the stations.
- High walkability gaps around all the stations — need footpaths, shade, crossings, and NMT connectivity.

4.10.3 Multimodal Integration Assessment

- No structured bus-metro interchange stops close to stops.
- IPT (auto-rickshaw) business very informal and congested.
- No proper cycle parking, feeder bus services, public bicycle sharing schemes.
- Inadequate and confusing signage for cyclists and pedestrians.
- Multimodality should be incorporated so that TOD succeeds and incorporated in planning intervention as well.

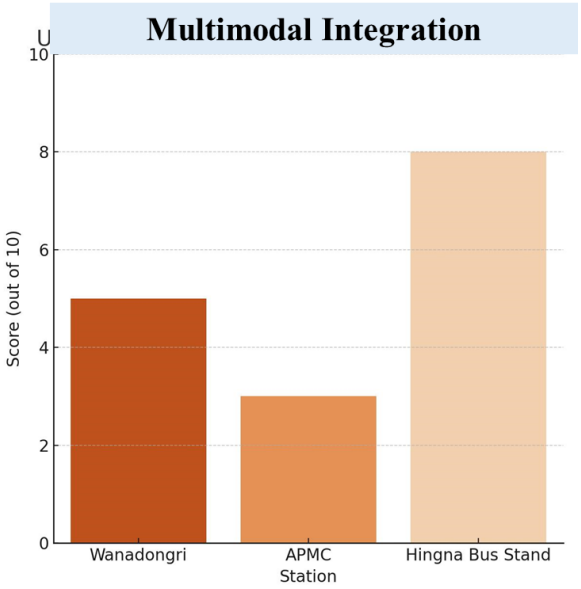


Figure 79-Multimodal Integration Assessment

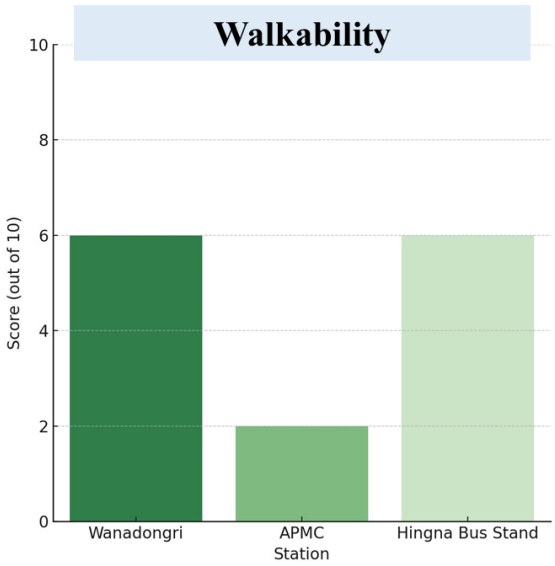


Figure 78-Walkability & Accessibility Analysis

Key observation

- Wanadongri: No integrated integration; completely dependent on personal vehicles.
- APMC: Congestion is too much; no exclusive parking or pickup/drop spot for the metro
- Hingna Bus Stand: Intermodal hub development potential with integration of state buses, IPT, and metro connectivity.

TOD Potential Identification

- Hingna Bus Stand: High TOD potential (transit hub focus)
- Wanadongri: Institutional TOD (student accommodations, mixed use).
- APMC: Walkability/public realm redesign after large market-based TOD.

4.11 LAND VALUE INCREASE TRENDS

Appreciation. in the value of land. is one of the most important indicator of transit impact and development Pressure. With the completion. of Nagpur. Metro Phase. 2, most nodes along the. Hingna corridor have seen significant appreciation, indicative of both real estate potential and emergent market demand.

Zone Along Corridor	Avg Land Value (Pre-Metro 2018–2020)	Avg Land Value (Post-Metro 2023–2024)	% Increase
Lokmanya Nagar	₹2,800/sqft	₹3,500/sqft	~25%
Rajiv Nagar	₹2,200/sqft	₹2,900/sqft	~32%
Wanadongri	₹2,000/sqft	₹2,900/sqft	~45%
APMC Station Area	₹2,600/sqft	₹2,800/sqft	~8%
Raipur Area	₹2,100/sqft	₹2,700/sqft	~28%
Hingna Bus Stand	₹1,800/sqft	₹2,500/sqft	~39%

Table 26 Land Value Increase (2018–2024)

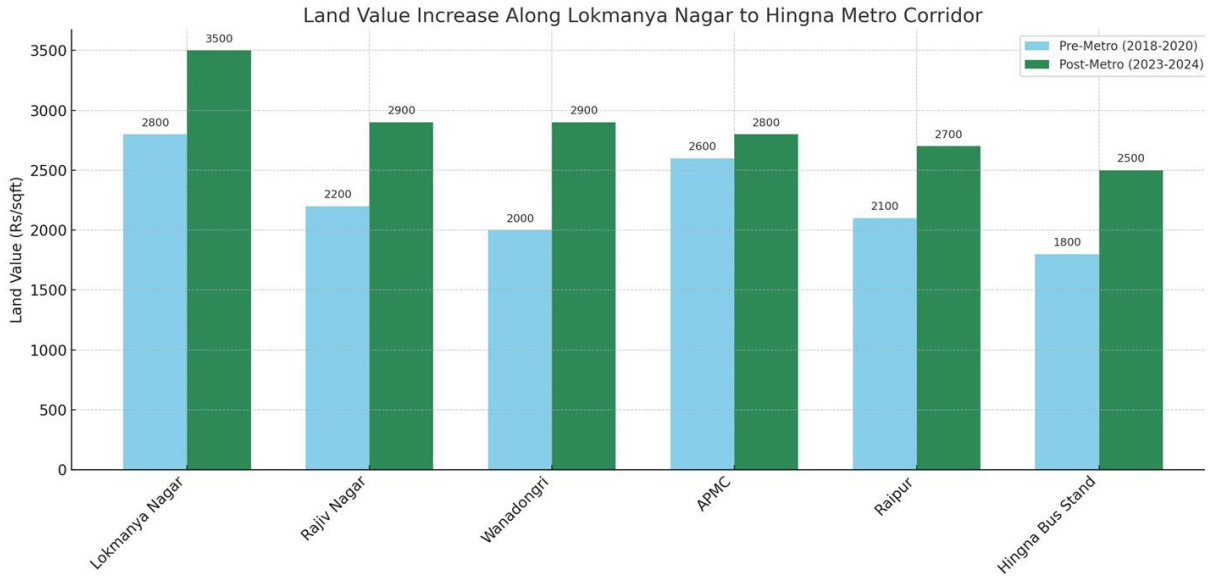


Figure 80-Land Value Increase

4.11.1Key observation

- **Highest Land Value Appreciation**:
  - Wanadongri experienced a ~47% appreciation owing to the rise in student-oriented housing (PGs/hostels) and the fact that it is close to YCCE and other schools.
  - Hingna experienced ~44% growth, fueled by the coming up of logistics parks, tiny IT offices, and warehouse construction.
- **Moderate Growth Areas:**
  - Rajiv Nagar and Raipur experienced steady appreciation (~30%) because of enhanced metro connectivity and residential intensification.
  - APMC node experienced only ~7%–10% growth with heavy traffic congestion, unorganized access, and inferior pedestrian/public realm.
- **Rental and Housing Trends:**
  - Wanadongri enjoys robust rental housing supply for working professionals and students.
  - Hingna reflects increasing demand for flexible commercial space and warehousing space.

4.11.2 Inferences for TOD Strategy

- **TOD Hotspots:** Hingna and Wanadongri qualify as TOD locations based on land availability, live market demand, and metro connectivity.
- **Stagnant Nodes:** APMC needs overall public realm development, congestion control, and multimodality to achieve its commercial sustainability.
- **Zonal Prioritization:** Policy priority and incentives must focus specifically on Hingna and Wanadongri for TOD pilots.
- **Market Sensitivity:** The corridor shows strong correlation of uplift in land value with supportive urban infrastructure and transit accessibility.

5. PROPOSALS

5.1 Proposal 1: Transit-Activated Corridor (TAC) Development

5.1.1 Concept & Objective

Title: Creating a Transit-Activated Linear Growth Spine along Lokmanya Nagar–Hingna Corridor

Transit-Activated Corridor (TAC) is a evolution of TOD, integrating land use, transit, and street design throughout a whole corridor not separate stations. It aims at linear intensification, walkable connected environments, and controlling overlays that structure development between nodes.

Objective: To activate the entire metro corridor through the introduction of a TAC Overlay Zone to form a continuous, high-density, mixed-use, transit-oriented urban spine, with maximum intensity and connectivity of land use.

5.1.2 Challenges

Currently, the corridor is marked by scattered land use, inadequate FSI absorption, small plots, and narrow roads limiting vertical growth. In addition to this, there also exists no regulatory provision favouring mixed-use development or eased planning controls along the corridor.

5.1.3 Strategies

The proposal involves a multi-phase implementation plan.

Phase 1: Policy Formulation

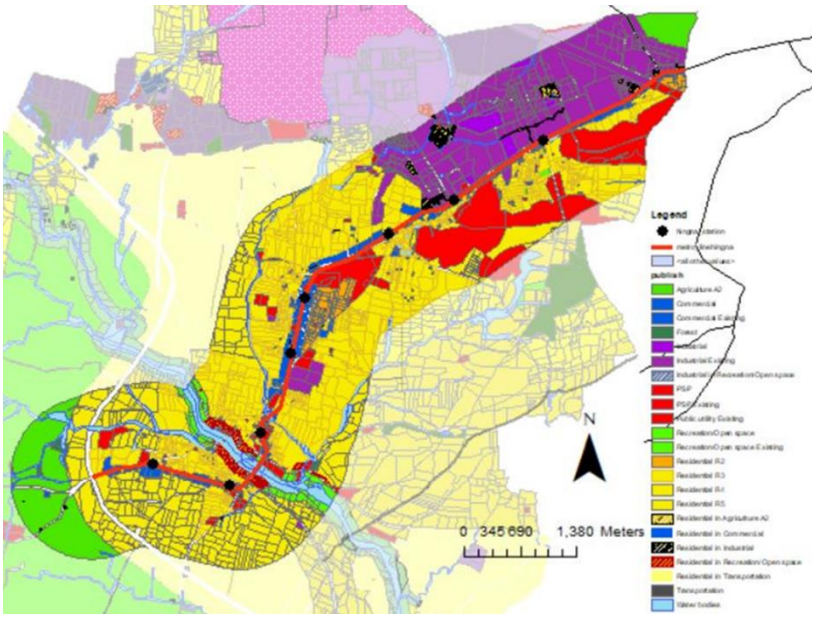
Phase 2: Regulatory Framework, Rules, and DCR Amendments

Phase 3: Infrastructure and Design Implementation

Phase 4: Land Development & Incentive Mechanisms

Phase 5: Monitoring & Evaluation

During Phase 1, the TAC buffer a 500m buffer along both sides of the Lokmanya Nagar–Hingna metro corridor as a "Transit-Activated Overlay Zone.“ will be formally notified in the Nagpur Development Plan, and an Urban Design Manual for the corridor will be developed to inform land use, building type, public realm treatment, and active frontage requirements. Landowner, institutional institution, and government department consultation will be undertaken for taking practical advice.



MAP 7-TAC buffer

DCR Reforms under TAC Overlay Zone

Regulation Area	Existing Norm	Proposed TAC Regulation
Land Use Zoning	Single use zoning (residential/commercial)	Mandatory mixed-use zoning within 250m of metro corridor
Base FSI	1.5–2.0	Increased to 2.5; up to 4.0 with premium charges
Minimum Plot Size	Minimum 300–500 sqm for high-rise	Permitted amalgamation and redevelopment of plots under 300 sqm under TPDS
Active Frontage	Not specified	Minimum 70% ground-floor frontage must be commercial or semi-public
Bonus FSI for Public Realm	Not applicable	10% additional FSI for dedicating 5% of plot for footpath/plaza

Table 27-Reforms under TAC Overlay Zone

Phase 2 focuses comprehensive regulatory reform through amendments Development Control Regulations (DCR). These involve permitting a minimum base FSI of 2.5 and premium FSI of up to 4.0 in the TAC zone, requiring mixed-use zoning within 250 meters of the corridor, and encouraging vertical building (G+6 to G+12) even on 9–12 meter road. Active frontages will be made obligatory to ensure vibrant, pedestrian-friendly

streetscapes. Incentives for public-private partnerships will be provided through measures like bonus FSI for dedication to footpaths, plazas, or vending areas.

Phase 3, Physical implementation will consist of redevelopment of Hingna Road as a comprehensive street with dedicated pedestrian and cycling facilities, vending bays, and smart lighting. Electric ride-hailing service and time-payment vending area will be introduced to provide last-mile connectivity in a convenient manner and provide public space access to all. A TAC Parcel Development Scheme (TPDS) will be introduced to enable small plot owners to enable micro-level land pooling and cooperative building approvals. This would also address the issue of divided ownership and proper utilization of land.

Infrastructure	Implementation Action
30m Road Upgradation	Reconstruct Hingna Road into a Complete Street: 3.5m x 2 lanes, 2.5m cycle track, 2.5m shaded footpath, vending bay, bioswale median.
Feeder Systems	Launch loop-based e-feeder shuttles. Designate stops every 500m.
Street Vending Strategy	Create linear vending zones on 1.5m side shoulders using modular, removable kiosks. Apply time-based vending licensing.
Pedestrian Networks	3m continuous shaded paths with tree buffer. Install tactile paving, bollards & crossings.
Green Public Realm	Green pocket (200–500 sq.m) along TAC for seating, vending, and public activity. Design as part of TOD open space norm compliance.

Table 29- Infrastructure and Design Implementation

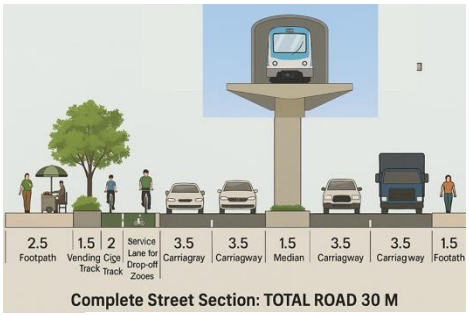


Figure 81 Road width

KPI	Target by 2031
FSI Utilization in TAC	>70% parcels using FSI above 2.5
Street Edge Activation	>75% ground-floor commercial on TAC roads
Public Realm Improvement	90% TAC corridor covered with footpaths, vending zones, and trees
Ridership Increase	25–30% increase in metro ridership from TAC zones

Table 28- Monitoring & Evaluation

A special TAC Cell will be established under NMRDA to oversee approvals, compliance, and implementation, and Urban Design Review Committee will handle architectural compatibility as well as quality of public spaces. Financing tools such as Land Value Capture (LVC), Transferable Development Rights (TDR), and joint development schemes will be used to mobilize finance for infrastructure as well as encourage participation. Indicators of performance will be FSI utilization, public realm coverage, metro ridership, and increase in tax revenues.

5.1.4 Final Outcome

Compact Linear City Spine replacing fragmented low-rise neighbourhoods. Increased Taxation Revenue & Land Value as a result of FSI and TOD-based commercial activity. Fair Development Model which involves small plot holders and cooperative redevelopment. With regulation-based approach, the TAC proposal aims to transform the corridor into a high-performing urban backbone which promotes smart growth, economic vitality, and revitalized balanced redevelopment.

5.2 Small Plot Redevelopment Policy (Micro-Level Land Pooling)

5.2.1 Concept & Objectives

Title- "Unlocking Vertical Potential in Fragmented Urban Fabric"

Objectives

- Allow for vertical redevelopment for neighborhoods consisting of small, narrow-frontage plots.
- Encourage cooperative land pooling of the owners under a reward scheme.
- Offer a legal and planning structure for mutual redevelopment.
- Facilitate effective utilization of public infrastructure and curb urban sprawl.

5.2.2 Challenges

One of the major Problem in achieving Compact and efficient redevelopments along the Lokmanya Nagar to Hingna metro corridor is the concentration of small scattered land plots usually below 300 square meters with narrow road access and normal DCR rules. The plots will tend to be underused, discourage vertical growth, and have little scope for upgradation of infrastructure due to scattered individual ownership patterns.

5.2.2 Strategy

To overcome this, the proposal establishes a Small Plot Redevelopment Policy via a micro-scale land pooling strategy within the Transit-Activated Corridor (TAC) Overlay Zone.

The concept is to enable voluntary amalgmation of plots between adjacent plot owners under a joint redevelopment scheme with the support of the planning agency, thus making way for the development of mid-rise buildings and shared facilities. These clusters will be known as Small Plot Redevelopment Zones (SPRZ) in the TAC buffer, where special

planning incentives. The owners of such cluster lands can join cooperative redevelopment societies to undertake collective redevelopment through specified private developers or public-private partnerships.

Minimum area requirement for a plot is chosen with in this plan, provided

Parameter	Existing DCR	Proposed Under TAC–SPRZ
Minimum Plot Size for Building	300 sqm	No minimum if consolidated with 3 or more adjoining plots
Permissible FSI	1.5–2.0	Base FSI 2.5; up to 3.5 with incentives
Height Restrictions	Road width-based	Allow G+6 on 9m roads if rear lane provided
Setbacks	As per standard	Relaxed: 1.5m front + 3m rear with shared services

Table 30-Parameters for Proposed SPRZ

amalgamation is a cluster of three or more small parcels together. The minimum FSI is to be raised to 2.5, with 3.5 being the maximum for projects providing collective public access or facilities.

Cluster Type	**No. of Plots**	**Total Area(sqm)**	**Redevelopment Typology**
Type A – Micro Cluster	3–4	450–1000	G+4 Residential or PG housing
Type B – Mid Cluster	5–8	1000–2000	G+6 Mixed-Use (Residential + Retail)
Type C – Large Cluster	8+	>2000	G+8 with podium, internal plaza, co-living

Table 31-Cluster Typology

The policy will also mandate active ground-floor frontage and encourage mixed-use redevelopment. Shared parking deals will be allowed, particularly for rented accommodation and co-living blocks. Student-oriented rental typologies such as PG accommodation, modular spaces, and co-living apartments will be specifically considered keeping in mind the institutional nature of such nodes like Wanadongri and Mount View.

The mechanism of implementation would be through a specialized TAC Cell of NMRDA that identifies the eligible clusters, enables cooperative society formation and offers single-window clearance. Bonus FSI (up to 10%) or TDR benefit shall be granted to the landowners who have consolidated land and dedicated part of their plots for public use (e.g., footpaths, vending places, parks).

5.2.3 Expected Outcome

This strategy will open up vertical growth opportunities in fragmented neighbourhoods without displacement, allowing low-income and institutional peripheral areas to become part of the corridor redevelopment. It will raise FSI utilization by 50–60%, raise land value, and optimize the supply of affordable rent housing near transit. By fostering bottom-up, cooperative redevelopment, this policy creates an inclusive model of urban renewal that complements the objectives of sustainable, transit-oriented planning.

5.3 Proposal-3 -Integrated Transit Node Redevelopment at Hingna Bus Station

5.3.1 Concept & Objectives

Title- Redevelopment of Hingna Metro Node as a Compact, Multimodal Transit Hub.

Concept

The proposal envisions Hingna Bus Station as an Integrated Transit-Oriented Node, combining metro, bus, and IPT connectivity with affordable rental housing and organized public space. As the terminal of Corridor 3A and a key access point for MIDC and Butibori workers, the site offers strong potential for a compact, multi-level urban hub. The development will integrate transit services with commercial functions and workforce housing, creating a walkable, efficient, and economically vibrant node.

Objectives

- To create an integrated multimodal hub by combining metro, bus, and IPT systems with safe pedestrian connectivity.
- To promote affordable rental housing and commercial development directly linked to transit infrastructure for enhanced accessibility and economic viability.

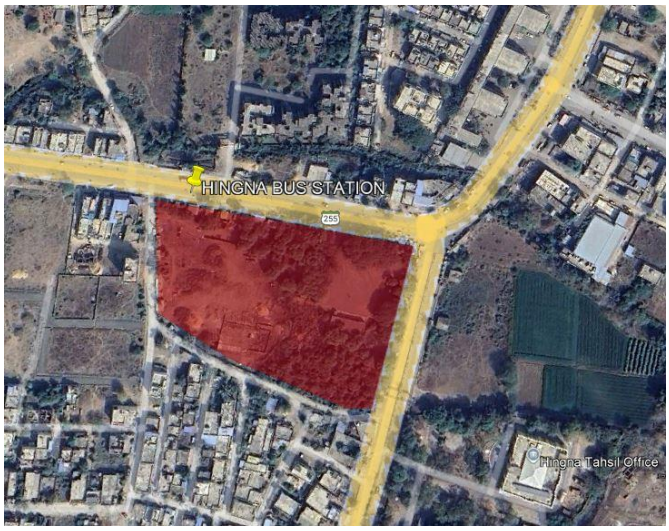


Table 32-HINGNA BUS STAND

5.3.2 Detail Proposal

A. Multimodal Ground-Level Hub Development

- **Bus Stand Reorganization**: Redesign existing MSRTC bus stand as a **loop-based system** with separate entry/exit, internal halt bays, and digital ticketing counters.
- **IPT Integration**: Create **two 10–15m dedicated IPT bays** (autos, e-rickshaws) with waiting shelters, queue systems, and charging points.
- **Metro-Pedestrian Connectivity**: A **3-meter shaded pedestrian path** will connect the metro station to the bus terminal and vending zones, with bollards and zebra crossings.
- **Vendor Formalization**: Introduce a linear **vending arcade with modular kiosks** (2m × 2.5m), arranged along the site's edge, supported by QR-code licensing and shared waste facilities.
- **Public Realm Improvements**: Tree-lined walkways, sitting zones, public toilets, and solar-powered smart lighting.

B. Vertical TOD Block Above/Adjacent to Metro Station.

Level	Proposed Use
Ground + Concourse	Metro station access, shared plaza, convenience shops, vending kiosks
Level 1–2	Retail arcade, food court, service outlets, and last-mile support facilities
Level 3–5	Affordable rental housing (1RK/Studio units) for workers and commuters
Rooftop	Solar panels, rainwater harvesting, community terrace or rooftop café

Table 33-Vertical TOD Block – Proposed Functional Distribution

C. Regulatory and Planning Framework

Component	Provision
Overlay Zoning	Notify 500m radius as Transit-Activated Corridor (TAC) Node
Permissible FSI	Base FSI: 2.5; Max FSI: 4.0 with public realm and housing incentives
Use Zone Flexibility	Mixed-use permitted: Commercial + Rental Housing + Transit Support Services
DCR Amendments	Allow airspace development over concourse; relax parking & setback norms
Vending Policy	Introduce QR-coded vending licenses and integrate with street edge design

Table 34- Regulatory and Planning Framework

5.3.3 Final Outcome

- Fully integrated multimodal transport hub serving metro, bus, and IPT users
- Transit-linked rental housing for over 200 workers with direct metro access
- Improved safety, accessibility, and experience for over 20,000 daily users
- Dignified vending system with revenue generation for PMC and MahaMetro.
- New economic activity zone anchored by affordable housing, services, and footfall.

5.4 Proposal 4-Sustainable Public Realm Design

(Green Mobility Corridor)

5.4.1 Concept & Objectives

Title- Creating public space – walkable, shaded, sustainable, and inclusive

The concept is to consider the entire Lokmanya Nagar to Hingna corridor as a Green Mobility Spine — a linear, climate-resilient, non-motorized transport (NMT)-friendly corridor prioritizing walkability, cycling, urban ecology, and climate adaptation. The vision is to reclaim public space as usable, breathable, inclusive space instead of auto infrastructure.

Objectives

- Extend safe and unbroken NMT connectivity to all metro stations.
- Green buffers, shaded sidewalks to mitigate urban heat.
- Transform Hingna Road as a complete street with space for people as well as mobility.
- Enable low-carbon commuting and healthier public space.

5.4.2 Challenges

Issue	Observation
No continuous footpaths	Disconnected walkways and unsafe crossings across the corridor
Lack of climate adaptation	No shaded paths, no tree canopy, and extreme surface heat
No cycle infrastructure	Two-wheeler dominated traffic with zero NMT lanes
Vehicular dominance	No hierarchy – autos, buses, pedestrians all use same lanes unsafely

Table 35-Existing Challenges

5.4.3 Detail Proposal

This proposal envisions the Lokmanya Nagar to Hingna metro corridor as a Green Mobility Spine that focuses on walkability, non-motorized transport (NMT), and climate-resilient urban planning. Rather than simply perceiving Hingna Road as an auto-centric highway, the plan sears it as an interconnected, people-friendly street—designated for pedestrians, cyclists, vendors, and public transport riders. The goal is to provide a secure, shaded, and sustainable corridor that promotes the use of the metro, minimizes urban heat, and enhances public health.

Zone	Width	Feature
Carriageway	7m (two lanes)	Shared by buses and private vehicles
NMT Cycle Track	2m	Segregated with bollards and green verge
Pedestrian Footpath	3m	Tiled, shaded, universally accessible
Green Buffer	1.5m	Native trees, bioswales, rainwater soak pits
Vending Edge	1.5–2m	Modular kiosks with shade and seating

Table 36-Hingna Road (TAC Corridor) Redesign

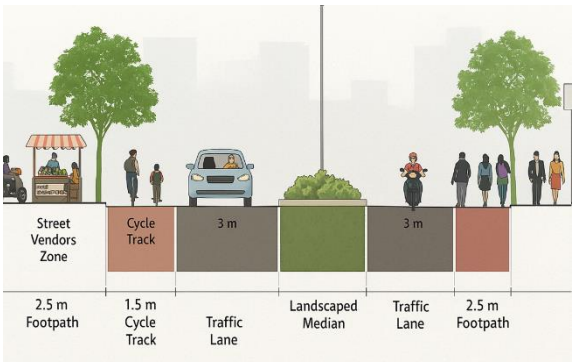


Figure 82-Road Section

5.4.4 Final outcome

The proposal will create an ongoing, secure, and climate-resilient public realm along the 6.6 km TAC corridor that will facilitate non-motorized mobility through shaded pedestrian routes and dedicated cycling infrastructure. Starting with a demonstration length of 2 km near Wanadongri assures phased, scalable rollout. Seamlessly integrated with feeder mobility infrastructure like e-rickshaw bays and cycle-sharing, the corridor will lower surface heat by 3–5°C, improve first- and last-mile connectivity, and radically enhance gender security and pedestrian equity. In all, it will enhance metro ridership by up to 30% and establish Hingna Road as Central India's first green, transit-oriented model corridor.

6. CONCLUSION

The proposed extension of the Nagpur Metro towards Hingna presents a transformative opportunity to steer urban growth in peripheral areas towards sustainability, inclusivity, and transit efficiency. This study comprehensively analyzed the 6.6 km corridor from Lokmanya Nagar to Hingna, identifying critical gaps in land use regulation, urban form, infrastructure provision, and multimodal integration. Despite its potential, the corridor faces challenges like small plot sizes, inadequate road widths, unplanned growth, and lack of last-mile connectivity—all of which hinder effective Transit-Oriented Development (TOD).

Through detailed station-wise assessments, land value trends, and population growth analysis, the study identified Wanadongri and Hingna as high-readiness zones for TOD implementation. Drawing insights from global and Indian case studies, the report proposes an integrated planning approach through five core strategies:

(1) Creation of a Transit-Activated Corridor (TAC) Overlay Zone with DCR amendments,

(2) Policy for micro-level land pooling to unlock small plot redevelopment,

(3) Integrated Transit Node Redevelopment at Hingna

(4) Transformation of Hingna Road into a sustainable public realm spine.

The success of these strategies depends on robust governance mechanisms, inter-agency coordination, incentivization for private participation, and continuous monitoring. Establishing a dedicated TAC Cell within the planning authority and involving local stakeholders will be crucial. Ultimately, this report presents a replicable model of corridor-level urban transformation, where transit infrastructure is not just a mobility solution but a strategic lever to build compact, accessible, and equitable cities. By aligning infrastructure with land use planning, Nagpur can emerge as a pioneer in transit-integrated urban development among India’s second-tier cities.

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